



The Blue Economy Handbook of the Indian Ocean Region

**Vishva Nath Attri
and
Narnia Bohler-Muller**

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The Blue Economy Handbook of the Indian Ocean Region

Edited by
Vishva Nath Attri
Narnia Bohler-Muller



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FOREWORD

On 9 October 2014, at the Council of Ministers Meeting of the Indian Ocean Rim Association (IORA), held in Perth, Australia, the Blue Economy was adopted as a priority area for IORA. Since then, IORA's Member States have organised conferences, workshops and dialogues, including the two Ministerial Conferences on the Blue Economy in September 2015 and May 2017 in Mauritius and Indonesia, respectively. A delegation from IORA, under my leadership, participated in the UN Conference on 'Our Oceans, Our Future' from 5 to 9 June 2017 in New York, United States of America, where IORA committed to the completion of *The Handbook on the Blue Economy of the Indian Ocean Region* by October 2017.

The Handbook is the pioneering project of Prof. Vishva Nath Attri, The Chair of Indian Ocean Studies, IORA, at the University of Mauritius, and Prof. Narnia Bohler-Muller, Executive Director at the Human Sciences Research Council (HSRC), Pretoria, South Africa.

The Handbook represents the viewpoints of scientists and social scientists vis-à-vis the three main pillars of sustainability - social, economic and environmental sustainability - emphasised in United Nations reports and other publications. IORA is committed to the development of a sustainable Blue Economy that will ensure the growth and prosperity of the Indian Ocean region. The Handbook comprises four sections and 20 chapters in total.

The Handbook also sets out the initiatives undertaken by Member States of IORA in promoting the Blue Economy in the Indian Ocean region. It concludes that IORA has successfully evolved an 'Appropriate Policy Frame', as a consequence of its deep involvement in the Blue Economy through wide discussions among stakeholders of the Blue Economy. In my view, the Handbook will serve as a source of 'Theory and Practice' of the Blue Economy for all those policy makers, academicians, researchers, students and business men and women who are interested in the sustainable development and inclusive growth of the Indian Ocean region.

I congratulate Prof. Vishva Nath Attri and Prof. Narnia Bohler-Muller for their efforts in completing the Handbook. The Handbook has been dedicated by the editors of the Handbook, and rightly so, 'To the prosperity of the people of the Indian Ocean region'.

K.V. Bhagirath
Former Secretary General
Indian Ocean Rim Association

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The editorial team responsible for compiling this Handbook wishes to extend its gratitude and appreciation to the many organisations and individuals that, directly or indirectly, contributed to the publication of this first Blue Economy Handbook of the Indian Ocean Region. The Handbook covers social, economic and environmental aspects, with a special focus on sustainability.

In the first instance, the editorial team wishes to extend its appreciation to the contributors, not only for agreeing to become part of this important project, but also for their responsiveness and adherence to the timelines and instructions throughout the different phases of the project. The deadlines were met, despite sometimes difficult circumstances and busy personal schedules. The authors' commitment to the project is commendable and greatly appreciated.

The Chair in Indian Ocean Studies (CIOS), Prof. Vishva Nath Attri, is grateful to the Human Sciences Research Council (HSRC) of South Africa for involving the CIOS in the project as Principle Project Leader, and for providing full financial support for the completion of the project.

Further, we are thankful to the governments of the Republic of Mauritius and the Republic of India for allowing the CIOS to undertake this project in addition to his other duties. Our thanks are also due to all the Members of the Advisory Committee of the CIOS, as well as the Vice-Chancellor of the University of Mauritius and his administration team, for providing full support throughout the project.

We owe our gratitude to Ambassador K.V. Bhagirath, former Secretary General of the Indian Ocean Rim Association (IORA), for his constant encouragement and inspiration to complete this Handbook. He has been instrumental in supporting the academic integrity of the project, in which scholars from different universities and research institutions from IORA Member States participated. We wish to express our thanks to South Africa's Department of International Relations and Cooperation (DIRCO) and, in particular, Ambassador Anil Sooklal, for his encouragement and support of the project.

We are thankful to Mr H.G. Anderson, Director of IORA, for his invaluable assistance, and to our colleagues at the IORA Secretariat in Mauritius and at the HSRC in Pretoria, South Africa, for their efforts in completing this immense task. In particular, we are grateful to Dr Elizabeth Kiguta, who assisted in assessing the chapters.

Prof. Vishva Nath Attri is very grateful to his spouse, Mrs Shashi Prabha Attri, for inspiring him to complete the Handbook and for her constant support although it meant that he had to devote the majority of his time to the project. Prof. Narnia

Bohler-Muller equally values the inspiration and support of her partner, David Muller, and his ability to endure all the stress that comes with such projects.

Our special thanks go to Ms Daniëlla Smit and Ms Eileen Bees for their assistance.

We would also like to thank the anonymous external referees and the publication team at the Africa Institute of South Africa (AISA) within the HSRC.

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He has published more than 65 research papers in various national and international journals and participates in international conferences abroad. He has: authored two policy briefs for the United Nations Global Sustainable Development Report, one in 2016 and one in 2017; delivered keynote addresses on the Blue Economy at the First Economy Dialogue organised by the Research and Information System for Developing Countries (RIS) Institute in August 2015, Goa, India, at the University of Mauritius in 2016, and at RIS in December 2016. He participated in the Blue Economy Forum Meeting of RIS in January 2017 and is a member of the Federation of Indian Chambers of Commerce and Industry's (FICCI) Task Force on the Blue Economy 2016-2017. He was responsible for organising training programmes, in collaboration with the United Nation Economic Commission for Africa (UNECA), on Preferential Trade Agreements in November 2015; a Resource Person for UNECA in November 2015 and for the United Nations Conference on Trade and Development (UNCTAD) in February 2017. He has also: been a session organiser and chair of sessions at the Western Economic Association International (WEAI) US in Japan, US, Singapore and New Zealand; and made presentations at Core Group Meeting on the Blue Economy, April 2017, Mauritius and at the Workshop on Tourism Destination Management in May 2017, Mauritius. He has supervised more than 15 PhD scholars, and 45 MPhil scholars have completed their dissertations under him. He is the Managing Editor of the *Journal of Indian Ocean Rim Studies* (JIORS), in collaboration with the Indian Ocean Rim Association, and is engaged in research on: the Blue Economy; International Trade and Financial Liberalisation; Maritime Safety and Security; Women's Empowerment; Global Development Issues.

Charles S. Colgan is Director of Research at the Center for the Blue Economy at the Middlebury Institute of International Studies at Monterey in Monterey, California, where he is also Editor-in-Chief of the *Journal of Ocean and Coastal Economics* and an Adjunct Professor of International Environmental Policy. He is Professor Emeritus of Public Policy & Planning in the Muskie School of Public Service at the University of Southern Maine, where he chaired the Graduate Program in Community Planning & Development. He is also Director Emeritus of the Maine Center for Business & Economic Research at USM. He served 12 years in the Maine State Planning Office, including positions as Maine State Economist and Director of the Maine Coastal Program. He received a BA from Colby College and a PhD in Economic History from the University of Maine.

Saroj Kumar Mohanty, PhD, is serving at the Research and Information System for Developing Countries (RIS), a New Delhi based think-tank supported by the Ministry of External Affairs, Government of India. As a trade economist, he has researched extensively on issues concerning the Blue Economy and the Indian Ocean Rim Association (IORA). He has been working on issues relating to bilateral and regional trading arrangements, South-South cooperation and multilateral trading issues. His current research interests are in the areas of, *inter alia*, Asian economic integration, Mega-Regional Trade Agreements, Latin American Countries (LAC), Africa, Regional Comprehensive Economic Partnerships (RCEPs), South Asian Association for Regional Cooperation (SAARC), Common Market for Eastern and Southern Africa (COMESA), bilateral trade agreements, regional fisheries trade, and global value chain. He has published a number of papers in national and international journals. He has several books to his credit. He is also presently heading India's Official Focal Point for the IORA academic group. He also served as Chairman of the Academic Group of the Indian Ocean Rim Association (IORA) in the years 2011-12 and 2012-13, when India was the Chair of IORA.

Emmanuel Owusu-Sekyere is an economist with 26 years of experience. Dr Owusu-Sekyere currently works as Chief Research Specialist at the Africa Institute of South Africa (AISA) in the Human Sciences Research Council (HSRC), where he leads the Sustainable Development research theme. He holds a PhD in Economics from the University of Pretoria and a Master's degree in Economic Management and Policy from the University of Strathclyde, Glasgow, Scotland. He has led several nationally representative studies in South Africa, spanning several sectors of the South African economy and society, on behalf of the National Development Agency (NDA), Fiscal and Financial Commission South Africa (FFC), Department of Home Affairs (DHA), National Research Foundation (NRF) and the HSRC. These include South Africa's mining sector, immigration, active citizenry engagement

and South Africa's fiscal space. As an experienced economist and econometrician, he has a strong expertise in the development of economic and business models and has extensive global consulting experience in these areas. Dr Owusu-Sekyere has trained many public sector institutions in many African countries and has also assisted in building country specific business and economic models for these countries. His principal areas of research expertise are in business economics, economic applications to business development, inclusive and sustainable growth and development, poverty and inequality, institutions and good governance, financial inclusion and remittances, monetary policy and fiscal policy in Sub-Saharan Africa. Dr Owusu-Sekyere has published in and also reviews for several international ISI/IBSS accredited journals and is a member of many professional bodies, both local and international. Dr Owusu-Sekyere has worked extensively as a consultant and also lectured at the University of Pretoria and Regent University College in Ghana. He speaks English and Flemish.

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Patrick Vrancken holds LLM and LLD degrees from the University of Cape Town and has 25 years of teaching, research and academic management experience at university level. He is the author of numerous research outputs in South African and internationally accredited law journals and books. Prof. Vrancken is the author of *South Africa and the Law of the Sea*, published by Martinus Nijhoff Publishers in Leiden and Boston in 2011. Since 1 July 2013 he has been the incumbent of the South African Research Chair in the Law of the Sea and Development in Africa, hosted by the Nelson Mandela University in Port Elizabeth, funded by the South African Department of Science and Technology, and managed by the South African National Research Foundation. He was Deputy Leader of the South African government's Operation Phakisa Marine Protection Services and Governance Lab held in Durban in 2014. Prof. Vrancken is a member of the International Law Association's Committee on International Law and Sea Level Rise. He is the managing editor of the *Journal of Ocean Law and Governance in Africa*.

Dennis Hardy is Vice-Chancellor of the University of Seychelles. He graduated with a first degree in Geography from the University of Exeter, UK, followed by an MA by research in Geography. From there he joined the Greater London Council and qualified at University College London as a professional urban planner. He later became a Fellow of the Royal Town Planning Institute. After an initial period in planning practice, he moved into academia. Following a varied programme of teaching and research, he became increasingly involved in university management at Middlesex University London and Dubai. He obtained a PhD through part-time research in Urban Planning History at the London School of Economics and, in 1988, was awarded a professorship. He has 10 well-received books to his name, and research and writing remain important aspects of his profile. He was formerly President of the International Communal Studies Association and is currently a Fellow of the Royal Society of Arts.

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Balasaheb G Kulkarni, born on 1 June 1954, was awarded a PhD by the University of Bombay in 1984 for a thesis entitled, 'Effect of some petroleum hydrocarbons on some marine organisms'. Prof. Kulkarni, who was the Director of the Institute of Science Mumbai from 2009 to 2014, is currently the Principal of Pune Vidyarthi Griha's College of Science and Technology, Mumbai. He has 36

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Ajuruchukwu Obi obtained degrees in Agricultural Economics, Economic Policy Management, and Human Rights Law from the University of Nigeria, McGill University, Canada, University of Fort Hare, and University of the Free State, South Africa. He has taught Agricultural Development Policy and Planning and Agricultural Marketing at Universities and worked with the United Nations system in Nigeria, Lesotho and Switzerland. He is Book Review Editor of the *International Journal of Agricultural Management* and Managing Editor (Africa region) of the *International Food and Agribusiness Management Review*. He is a member of the Rutgers University Consortium on smallholder transformation under USAID's

Feed-the-Future programme and frequently consults for the Forum for Agricultural Research in Africa (FARA) for the Comprehensive African Agricultural Development Programme (CAADP) and Science Agenda for Africa's Agricultural Development. Professor Obi publishes widely and has supervised 12 PhDs, 5 Post-doctoral Fellowships, 50 MSc students, and close to 100 Honours students.

Daniel O Okeyo is involved in the Forum on China-Africa Cooperation (FOCAC) and is an authority on lacustrine, riverine and marine fish diversity, which has been his professional field for 25 years. He is currently the Coordinator of Aquaculture, Aquatic and Marine Sciences at the University of Fort Hare, Eastern Cape, South Africa. He has served as the Coordinator of Aquatic Sciences at Kenyatta University, Nairobi, Kenya (1987-1995), headed the Department of Biological Sciences at the University of Namibia (1995-2001), and held the position of Executive Dean of the Faculty of Science and Technology at the University of Fort Hare (2001-2007). He has, in addition, authored an e-book entitled *A photo guide to freshwater fishes of Kenya*, which he developed free of charge, as a contribution for the world's African fish lovers. He has a further two books under review: his autobiography entitled *An Orphan with a global family*; and, *Bakenye: a people with no written language*. The latter is dedicated to fisher communities.

Thokozani Simelane is a Chief Research Specialist and the Acting Director of Research at the Human Sciences Research Council. He holds a PhD in biodiversity management from Nelson Mandela Metropolitan University and a Doctor of Engineering from the Durban University of Technology. He is a member of the Human Sciences Research Council's Research Ethics Committee. He is also a member of South Africa's standing advisory committee on Intellectual Property Rights, where he serves as a member of the Patents sub-committee. He is a founding Member of South Africa's Chapter of International Systems Dynamics Society, where he served as a member of Council until 2016. He has co-edited six book volumes and published more than 20 book chapters and 15 articles in peer reviewed journals. His research interests include: systems analysis; biodiversity and environmental management; science and technology; intellectual property development; and management and renewable energy.

David Obura is a Director of Coastal Oceans Research and Development (CORDIO) in East Africa, a knowledge organisation supporting sustainable management and the conservation of coral reef and marine systems in the Western Indian Ocean. CORDIO integrates research with management and policy, builds capacity, and works with stakeholders, managers and policy makers. Dr Obura's primary research is on coral reef resilience, with particular reference to climate change

and the bio-geography of Indian Ocean corals, and he has worked extensively in the field of coral reef monitoring. This work provides a platform for contributing to regional-scale marine management, with a current focus on the Northern Mozambique Channel, so as to design and promote an Integrated Ocean Management approach that delivers on Blue Economy development principles. Dr Obura is also working on ways to bring knowledge into practical frameworks to respond to local needs and national and intergovernmental goals, as expressed in the UN Sustainable Development Goals.

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Geeta Devi Somaroo is senior lecturer in the Chemical and Environmental Engineering Department at the University of Mauritius. She has a PhD degree in Chemical Engineering, which focused on an assessment of the degradability of plastic carry bags in a composting environment and the determination of environmental impacts using a life cycle approach. Dr Somaroo is involved in various national and international research projects in the field of composting, anaerobic digestion, waste characterisation studies and life cycle analysis. She also has authored a number of research and conference papers that have appeared in international journals such as *Waste Management* and *Bioresource Technology*.

Marie Valerie Uppiah is a lecturer in International Trade Law and Maritime Law at the University of Mauritius. Ms Uppiah has a BA (Hons) in Law and Management from the University of Mauritius (Mauritius) and an LLM in International Business Law from Birmingham City University (UK). She is currently completing a doctoral study in law at the University of Pretoria, South Africa. Ms Uppiah

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ABBREVIATIONS AND ACRONYMS

AAMA	Association of African Maritime Administrations
AEC	African Economy Community
AIM	Africa Integrated Marine
AISA	Africa Institute of South Africa
AMD	Africa's Maritime Domain
AMTC	African Maritime Transport Charter
ASCLMEP	Agulhas-Somali Current Large Marine Ecosystem Programme
AU	African Union
BE	Blue Economy
BEC	Blue Economy Conference
BFDAs	Brackish water Fish Farmers Development Agencies
BFR	Big Fast Results
BOE	barrel of oil equivalent
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environment Enforcement
CAADP	Comprehensive African Agricultural Development Programme
CAUTHE	Council of Australasian University Tourism and Hospitality Educators and Researchers
CBD	Convention on Biological Diversity
CCEAWM	Continental Conference on the Empowerment of African Women in Maritime
CCI	Caribbean Challenge Initiative
CEMZA	Combined Exclusive Maritime Zone
CICES	Common International Classification of Ecosystem Services
CIFA	Central Institute on Freshwater Aquaculture
CIOA	Cruise Indian Ocean Association
CIOS	Chair in Indian Ocean Studies
CLCS	Commission on the Limits of the Continental Shelf
CLME	Caribbean Large Marine Ecosystem
CMSP	Coastal and Marine Spatial Planning
COL	Commonwealth of Learning
COMESA	Common Market for Eastern and Southern Africa
CORDIO	Coastal Oceans Research and Development in the Indian Ocean
CRFM	Caribbean Regional Fisheries Mechanism
CRIFF	Caribbean Catastrophic Risk Insurance Facility
CSP	Concentrating Solar Power

DAFF	(RSA) Department of Agriculture Forestry and Fisheries
DEA	(RSA) Department of Environmental Affairs
DHA	(RSA) Department of Home Affairs
DMR	(RSA) Department of Minerals Resources
DOT	(RSA) Department of Transport
DOWA	Deep Ocean Water Applications
DPW	Department of Public Works
DST	(RSA) Department of Science and Technology
E&P	Exploration and Production
EAC	East Africa Community
EBM	Ecosystem-Based Management
EB-MSM	Ecosystem-Based Marine Spatial Management
ECROP	Eastern Caribbean Regional Oceans Policy and Action Plan
EESA	The Experimental System of Ecosystem Service Accounts
EEZ	Exclusive Economic Zones
EIA	U.S. Energy Information Administration
ENOC	Emirates National Oil Company
ENSO	El Nino-Southern Oscillation
EPE	Environmental Performance Evaluation
ESESA	Experimental System of Ecosystem Services Accounts
EU	European Union
FAO	Food and Agriculture Organisation
FARA	Forum for Agricultural Research in Africa
FFC	(RSA) Fiscal and Financial Commission
FFDA	'Fish Farmers' Development Agency
FICCI	Federation of Indian Chambers of Commerce and Industry
FOCAC	Forum on China-Africa Cooperation
FOSP	Future Ocean Spatial Planning
GDP	Gross Domestic Profit
GEF	Global Environment Facility
GNH	Gross National Happiness
GNI	Gross National Income
GOOS	Global Ocean Observing System
GS	Genuine Savings
GVC	Global Value Chain
HACCP	Hazard Analysis and Critical Control Point
HDI	Human Development Index
HSRC	Human Sciences Research Council
ICC	International Chamber of Commerce
ICSU	International Council for Science

ICT	Information and Communication Technology
ICZM	Integrated Coastal Zone Management
IEA	International Energy Agency
IGAD	Intergovernmental Authority on Development
IMCAM	Integrated Coastal and Marine Area Management
IOR	Indian Ocean Region
IORA	Indian Ocean Rim Association
IOTC	Indian Ocean Tuna Commission
IPCC	Intergovernmental Panel on Climate Change
ISA	International Seabed Authority
ISIC	International Standard Industrial Classification
ISSC	International Social Science Council
IT	Information Technology
IUCN	International Union for the Conservation of Nature and Natural Resources
IUU	Illegal, Unreported, Unregulated Fishing
IWC	International Whaling Commission
JPI	Joint Programming Indicatives
LAC	Latin African Countries
LOSC	Law of the Sea
MARPOL	International Convention for the Prevention of Pollution from Ships
MARS	Marine and Antarctic Research Strategy
MEA	Millennium Ecosystem Assessment
MLC	Maritime Labour Convention
MoU	Memorandum of Understanding
MPA	Marine Protected Area
MRC	Mauritius Research Council
MSP	Marine Spatial Planning
MSY	Maximum Sustainable Yield
MTJA	Malaysia-Thailand Joint Authority
MTM	Maritime Transport and Manufacturing
NAICS	North American Industry Classification System
NDP	National Development Plan
NDT	National Department of Tourism
NMSC	National Marine Science Committee
N-OCIMS	National Oceans and Coasts Information Management System
NOEP	National Ocean Economics Program
NPV	Net Present Value
NRF	(RSA) National Research Foundation
O&G	Oil & Gas

OA	Ocean Acidification
OAU	Organisation of African Unity
OEA	Ocean Environmental Awareness
OECD	Organisation for Economic Co-operation and Development
OECS	Organisation of Eastern Caribbean States
OHI	Ocean Health Index
OPEC	Organisation of Petroleum Exporting Countries
OP-OE	Operation Phakisa Ocean Economy initiative
OTEC	Ocean Thermal Energy Conversion
PEMSEA	Partnerships in Environmental Management for the Seas of East Asia
PSC	Port State Control
RCEP	Regional Comprehensive Economic Partnership
RECs	Regional Economic Communities
RFMO	Regional Fisheries Management Organisations
RIS	Research and Information System for Developing Countries
RSP	Regional Seas Program
SAARC	South Asian Association for Regional Cooperation
SADC	Southern African Development Community
SAEON	South African Environmental Observation Network
SAIMI	South African International Maritime Institute
SA IORAG	South African Chapter of the Indian Ocean Rim Association Academic Group
SAMIC	South African Maritime Industry Conference
SAMOA	SIDS Accelerated Modalities of Action
SAMREF	South African Marine Research and Exploration Forum
SAMSA	South African Maritime Safety Authority
SDG	Sustainable Development Goal
SEEA	System of Economic and Environmental Accounts
SERPENT	Scientific and Environmental ROV Partnership using Existing Industrial Technology
SeyCCAT	Seychelles Conservation and Climate Adaptation Trust
SIC	Standard Industrial Classification
SIDS	Small Island Developing States
SMPA	Special Marine Protected Area
SMS	Seafloor Massive Sulphide
SNA	Systems of National Accounts
SOOP	Ship-of-Opportunity Programme
STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
TEU	Twenty-Foot Equivalent Unit

TTI	Tourism Training Institute
TVET	Technical Vocational Education and Training
UAE	United Arab Emirates
UN	United Nations
UNCLOS	United Nations Convention on Law of the Sea
UNCSD	United Nations Conference on Sustainable Development
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environmental Programme
UNFCCC	UN Framework Convention on Climate Change
UWI	University of the West Indies
VOS	Voluntary Observing Ship
WATO	We are the Oceans
WAVES	Wealth Accounting and Valuation of Ecosystem Services
WCED	World Commission on Environment and Development
WIO	West Indian Ocean
WIOMSA	West Indian Ocean Marine Science Association
WOMESA	Women in the Maritime Sector in Eastern and Southern Africa
WTTC	World Travel and Tourism Council
WWF	World Wildlife Foundation

INTRODUCTION

The Beginning of the Journey

Vishva Nath Attri and Narnia Bohler-Muller

The Blue Economy, as an emerging development paradigm, is essentially an evolutionary concept that provides a solution to what has been articulated as limits to growth.

If the present growth trends in the world population, industrialization, pollution, food production and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next one hundred years. The most probable result will be a rather sudden and uncontrollable decline in both population and industrial capacity.¹

The above statement has been widely debated among scholars. Whilst not going into the merits and demerits of limits to growth, we may hypothesise that the Blue Economy (also known as blue growth) has emerged as an alternative model of development to ensure inclusive growth and prosperity in the world. Reports by the United Nations and other international and regional organisations, analysed in the various chapters, indicate that the Blue Economy has the potential to generate employment and growth across the world.

This Handbook focuses on the Indian Ocean region, and is the first attempt to present the different shades of the Blue Economy, as well as the perceptions of different stakeholders on the process of harnessing resources from the ocean for the socio-economic benefit of people across the region. Therefore, the Handbook consists of viewpoints of scholars across disciplines and is aimed at understanding this new paradigm in the context of people-oriented sustainability.

Although there is no consensus across and within disciplines about the definition and meaning of the Blue Economy, we have settled on one that attempts to encompass the relevant elements agreed on by most. Although the World Bank acknowledges the different aspects of the Blue Economy, it settles on the following definition:

Although the term “blue economy” has been used in different ways, it is understood here as comprising the range of economic sectors and related policies that together determine whether the use of oceanic resources is sustainable. An important challenge of the blue economy is thus to understand and better manage the many aspects of oceanic sustainability, ranging from sustainable fisheries and ecosystem health to pollution.²

However, chapter authors highlight different scholarly perspectives, and thus place emphasis on different aspects of the Blue Economy. In an attempt to retain the authenticity of the voices which follow, we have made a conscious effort not to change the work of the authors unduly. The expertise of these scholars ranges from economics and law to social and natural sciences. The inconsistencies that exist in the viewpoints expressed are illustrative of the need for further research in this area, and allow us to identify gaps and challenges that need to be addressed. We address some of these gaps and policy opportunities in the conclusion to this book.

This is only the beginning of the journey of understanding the Blue Economy and its potential. The emphasis on the Indian Ocean region is important for the following reasons:

- It is the third largest of the world's oceans, covering 70 560 000 km² (27 240 000 sq. miles) and comprising approximately 20 per cent of the water on the Earth's surface.³ The mere size of this region makes it remarkable.
- Climate change is affecting the Indian Ocean negatively, which places a strain on the ability to ensure food security, and damages the economies of small island states that depend on fisheries and aquaculture for their livelihoods. Research has shown that increasing ocean temperatures are taking a toll on the marine ecosystems. A study of the phytoplankton changes in the Indian Ocean indicates a decline of up to 20 per cent in marine phytoplankton in the Indian Ocean, during the past six decades.⁴ The tuna catch rates have also declined abruptly during the past half century, mostly due to increased industrial fishing, with ocean warming adding further stress to fish species.⁵
- Trade is flourishing in the region. The sea lanes in the Indian Ocean are considered among the most strategically important in the world, with more than 80 per cent of the world's seaborne trade in oil transiting through the Indian Ocean and its vital choke points.⁶
- The Indian Ocean provides major sea routes connecting the Middle East, Africa, and East Asia with Europe and the Americas. It carries particularly heavy traffic of petroleum and petroleum products from the oil fields of the Persian Gulf and Indonesia.⁷ An estimated 40 per cent of the world's offshore oil production

comes from the Indian Ocean.⁸ This exploitation is good for the Gross Domestic Product (GDP) of some countries and may lead to economic growth, but over-exploitation may lead to future problems - hence the need for sustainability.

It is made clear throughout the book that driving economic growth through use of the oceans should not lead to the type of damage already caused on land.

Structure of the book

The book comprises four sections. Section I deals with the context and theory of the Blue Economy from a general perspective. The chapters in this section grapple with the complexities of the Blue Economy and attempt to find a common understanding of what it means today. Needless to say, there are no easy answers. Section II deals with the governance and policy frameworks of the Indian Ocean region, without which there would be no control over the exploitation of resources and the conflict over sovereignty. Section III focuses on the economic and social benefits of the Blue Economy, which must be balanced, as emphasised earlier. Section IV provides perspectives on climate change, environmental protection and the role of science, technology and innovation in the ocean-space. The chapters in each of these four sections attempt to break new ground in understanding the impact of the Blue Economy on our future, while keeping in mind the Sustainable Development Goals, and in particular goal 14.

In this '21st Maritime Century', cooperation at regional and international level is a precondition for promoting mutually beneficial blue partnerships. International and regional systems of cooperation that are based on the principles of equity and inclusiveness need to be encouraged – in which developed, developing, emerging countries and small island states play an equally important role – and space must be created for architectures of ocean governance, in order to exploit the resources within respective exclusive economic zones (EEZs), while keeping in mind the future and the effects and impact of exploitation. The Indian Ocean Rim Association (IORA) is a regional body that has taken upon itself the responsibility of ensuring cooperation in the Indian Ocean Region (IOR). The Blue Economy and gender empowerment are priority issues agreed upon by the 21 Member States of the Association.⁹

It is our understanding that maritime peace and security are necessary pre-requisites for the promotion of the Blue Economy in the Indian Ocean Region. Section II of the book is based on various country-specific studies and covers the need for a cooperative, collaborative, equitable and inclusive regional architecture for governance of the Indian Ocean Rim that is in line with the provisions of the

United Nations Convention on the Law of the Sea (UNCLOS). This volume, the first of its kind, is focussed on the developmental trajectory of the Blue Economy and, as such, there is no separate chapter dealing explicitly with the peace and security challenges of the region. As mentioned, we acknowledge and accept that peace is a precondition for prosperity in the Indian Ocean region, and a discourse on the Indian Ocean as a Zone of Peace has been re-opened (see UN Resolution of 1971).¹⁰ The rule of law applies equally to land and sea, and this is not disputed in any way.

In the remaining part of this introductory chapter, we provide an outline of the chapter foci and how they weave together to paint a picture of the Blue Economy in the Indian Ocean region.

From theory to strategy to action

Section I of *The Blue Economy Handbook of the Indian Ocean Region*, entitled ‘Context and Theory of the Blue Economy’, consists of five chapters. This section serves as an overview of the theoretical developments regarding the concept of the Blue Economy, with a focus on the theory of paradigm shift, strategies related to the Blue Economy, evolving an accounting framework, sustainability, and the mainstreaming of gender. Thus, this section, strives to build an appropriate ‘theoretical construct’ of the Blue Economy for the first time. It is, of course, still in the making, and will be for some time to come as we grapple with its complexities and debate issues of growth and exploitation within the limits that humanity faces.

In Chapter 1, Attri engages with the Blue Economy in relation to the Paradigm Shift theory. He describes the Blue Economy as essentially an interdisciplinary, evolutionary and emerging new alternative development paradigm. This first chapter explores the importance of the Blue Economy and related concepts, such as the Green Economy, the Ocean Economy, the Marine Economy, and the Circular Economy. After considering the evolution of the Blue Economy concept in the 1950s, Attri moves on to recent developments, such as the global contribution of the Blue Economy, and ends with the principles and characteristics of the Blue Economy within the context of the IOR and the IORA.

Attri argues that the Blue Economy should be managed in innovative ways, so as to ensure economic benefits to Small Island Developing States (SIDS) as well as coastal, developing and developed countries. In his view, the Blue Economy may or may not be a paradigm shift, as its occurrence depends on favourable future developments. The identification of the central core of the Blue Economy is a major challenge for scientists and social scientists, as illustrated in all the chapters of this Handbook. He ends by highlighting that IORA, through its two Ministerial Conferences on the Blue Economy, has been successful in evolving a Comprehensive Policy

Framework for achieving sustainable development through the implementation of Blue Economy initiatives, which bodes well for the future in the region.

In Chapter 2, Colgan describes the Blue Economy as an integrated approach to economic development and environmental sustainability based on the resources of oceans and coasts. Elaborating on the Blue Economy strategies of a number of IORA Member States, Colgan points out the commonalities that exist within the region in reaching for development, while acknowledging the environmental limitations to growth. The chapter identifies a strategic framework that would be required to transform the Blue Economy from a mere goal into action and implementation. Colgan argues cogently that the Blue Economy has the potential to transform regions and nations, especially SIDS, and recommends the design of a Blue Economy action programme for the IOR.

Remaining within the theoretical and conceptual framing of the Blue Economy, in Chapter 3, Mohanty describes the evolution of the Blue Economy development paradigm as 'eclectic', as it combines elements of both 'growth-oriented' and 'sustainable development' approaches. Mohanty further submits that the scope of the Blue Economy is wider and more inclusive than both the coastal and ocean economies. After providing an overview of definitional issues relating to the Blue Economy, Mohanty considers an analytical accounting framework for the estimation of the Blue Economy in relation to India. In terms of his conception of the 'global blue voice', he argues for an evolving global framework for the accounting and estimation of the Blue Economy.

In Chapter 4, Owusu-Sekyere discusses the important matter of achieving sustainability in the context of the Blue Economy. The author highlights the need to discuss sustainability in the context of the Blue Economy, with the objective of exploring how the economic benefits of the oceans can be optimised in a socially inclusive and environmentally responsible way. The chapter addresses sustainability as a dynamic concept and highlights the challenges in realising Sustainable Development Goal (SDG) 14 on life under the ocean. Owusu-Sekyere points out institutional barriers to the sustainability of Blue Economy initiatives in some IORA Member States and proposes indicators that measure sustainability in the Blue Economy as a useful tool for policy-makers in the region.

In the author's view, the major challenge to extracting the benefits of the Blue Economy is the need to ensure the health of the oceans and to conserve and preserve them sustainably. Differentiating between 'soft' and 'hard' challenges, he recommends that both types of challenges – especially in waters beyond the territorial boundaries of any specific country - need to be resolved amicably for the success of Blue Economy in the Indian Ocean region.

Verma's chapter focuses on the need for inclusive, sustainable and employment-orientated development for women. The chapter focuses on the importance of

gender equality and including a gender perspective in Blue Economy initiatives. In this fifth chapter of the Handbook, she illustrates recent 'blue initiatives' by African women and welcomes the fact that IORA has introduced gender mainstreaming as a cross-cutting priority area.

In particular, Verma's study makes a case for the creation of more jobs for women in newly emerging industries in the Blue Economy, in addition to fisheries and aquaculture. In building on the Mahe Declaration, Verma argues that IORA needs to systematically take more concrete steps to generate gender statistics for Member States and to ensure a sustained focus on gender perspectives and women's empowerment in the policies and programmes related to the Blue Economy. A huge challenge is that gender-disaggregated statistics are almost non-existent in most of the IORA countries, which makes policy formulations all the more difficult. The systematic integration of gender into national statistics, capacity building, and socio-cultural changes are needed to reduce gender inequality in future. Ultimately, institutional factors play a crucial role in designing and implementing appropriate micro and macro level strategies in ensuring gender parity in the IOR.

Governance and policy frameworks

Section II of this Handbook, entitled 'Indian Ocean Governance and Policy Frame', consists of four chapters. This section provides an overview of developments that focus on the United Nations Convention of the Law of the Sea (UNCLOS), African governance perspectives on the Blue Economy in the IOR, challenges of Indian Ocean governance in the context of the Seychelles, and IORA's Regional Policy Framework on the Blue Economy. It is argued by all the authors that the regional architecture of ocean governance should be based on cooperation, collaboration, and equity, and should be in line with international norms and standards.

In Chapter 6, Ntola builds on the relevance of UNCLOS to the Blue Economy in the context of IORA. To date, 17 of the 21 IORA Member States have ratified the 1995 Convention. It is strongly recommended that all Member States of IORA should ratify this agreement, as its Charter makes explicit reference to UNCLOS as the international framework within which the region should operate. It is suggested by the author that IORA should develop its regional architecture with regard to marine pollution according to the UNCLOS cooperation provisions, as well as cooperation in areas essential to Blue Economy development in terms of the rules of international law.

In Chapter 7, Ntola and Vrancken discuss ocean governance and its relationship with the Blue Economy from the viewpoint of Africa, with an emphasis on UNCLOS III and continental governance frameworks. The authors highlight that

all African Member States of IORA have ratified UNCLOS and have, for the most part, established the legal zones for which it makes provision. The authors also point out that, at a continental level, the manner in which the African Member States of IORA are to operate is provided for in continental governance frameworks, such as Africa's Integrated Maritime Strategy (2050 AIM Strategy) as well as the regional governance frameworks, including the Common Market for Eastern and Southern Africa (COMESA), the Eastern African Community (EAC), the Intergovernmental Authority for Development (IGAD) and the Southern African Development Community (SADC). The chapter concludes that continental and regional governance frameworks accommodate Blue Economy development in Africa. The good practices of Mauritius, Seychelles and South Africa in prioritising specific Blue Economy intervention areas should be used to assist Least Developed Countries (LDCs) in developing their own interventions based on local context.

Hardy's Chapter 8 deals with the challenges of Indian Ocean governance and focuses on the context of Seychelles. Hardy clearly highlights the importance of effective systems of ocean governance for the full realisation of the Blue Economy in the Indian Ocean region and the Rim Association. A case study of the Republic of Seychelles is used to illustrate some of the general arguments. Being a small nation (in terms of land and population size rather than the extensive area of ocean over which it has jurisdiction), Seychelles provides a revealing study of different aspects of ocean governance and is exemplary, not only for small island states, but also for other seaboard nations. The chapter emphasises that, while all levels of governance need to be strengthened, it is time to look more specifically at the role of the region. The author suggests that a radical break with the past is required for IORA to act as an effective regional body for ocean governance, by encouraging all its Member States to produce their own national strategies in respect of Exclusive Economic Zones (EEZs).

In Chapter 9, Sadally outlines the regional association's Policy Framework on the Blue Economy and provides a detailed analysis of initiatives for evolving an appropriate, actionable and deliverable policy, with the emphasis on cooperation with IORA's dialogue partners, as well as support from the private sector. It is noted that IORA has been successful as a regional body in evolving an actionable policy framework for exploiting resources from the ocean in a sustainable manner. Part of this success can be attributed to the three Blue Economy Core Group Workshops conducted from 2015 to 2017 by South Africa's Human Sciences Research Council with the support of the Republic of South Africa and the IORA Secretariat, and to the agreement made in 2017 to establish a Blue Economy Working Group for IORA. Active political commitment is needed to ensure the adoption of the Blue Economy as an alternative development paradigm that would ensure the prosperity of the Indian Ocean region and the well-being of her peoples.

The socio-economic benefits of the Blue Economy

Section III comprises five chapters. This section provides a detailed analysis of the potential socio-economic benefits arising out of the implementation of the Blue Economy by the Member States of IORA: South Africa's Ocean Economy and Operation Phakisa, the employment potential of fisheries and aquaculture, oil and gas exploration in the Indian Ocean region, tourism and economic growth in the Indian Ocean region and ocean renewable energies. It is the considered view of all the chapter authors in this section that the Blue Economy offers tangible gains to the region, provided there is mutual cooperation and benefit. Adopting best practices would allow for efficient realisation of the Blue Economy.

In Chapter 10, Findlay and Bohler-Muller focus on the potential of South Africa's Operation Phakisa (OP) to ensure economic and social gains by exploiting the ocean. This initiative was inspired by Malaysia's Big Fast Results Methodology and began in 2014. OP aims to increase South Africa's ocean economy contribution from R54 billion to R177 billion and aims to create between 800 000 to 1 million jobs by 2033. The chapter identifies nine ocean economy areas and discusses the synergies between Operation Phakisa and Africa's maritime strategies in detail.

The hope is expressed that the South African experience in Operation Phakisa will assist other Member States in planning their approaches to the Blue Economy, just as South Africa will learn from other Member States that may be well advanced in the development of Blue Economy initiatives, as part of a process of mutually beneficial learning, knowledge sharing and skills transfer.

In Chapter 11, on the employment potential of fisheries and aquaculture, Kulkarni focuses on the employment generation potential of fisheries and aquaculture at a global level, and on production trends and the economic significance of fisheries, including trade trends, issues related to fisheries subsidies and over-exploitation of wild fish. The chapter highlights case studies from India and Mauritius. The author emphasises challenges such as climate change, ocean warming and the acidification of oceans that may severely harm production, as well as the job potential of fisheries and aquaculture in IORA. The proper management of aquaculture and fisheries is essential to keep generations of people in jobs in this sector of the Blue Economy, as well as to ensure food security.

Van Rhee, Hermes and Findley address oil and gas exploitation in the Indian Ocean region in Chapter 12. They focus on offshore oil and gas reserves within the EEZs of countries adjacent to the Indian Ocean at sub-regional level, covering all Member States of IORA. The authors highlight the fact that developing countries in the region are not able to optimise the off-shore production of oil owing to two main constraints: (i) foreign involvement and risk, and; (ii) lack of national capacity. As signatories to the Paris Agreement of 2015, countries are also committed

to shifting to renewable energies as an alternative to fossil fuels. The authors conclude that the decommissioning of operations is one area in which IORA countries could work together to establish guidelines or policies for emerging industries. In addition, they argue that the hydrocarbon industry has huge potential in the Indian Ocean region and that emphasis must be placed on responsible management of the industry to protect the environment for future generations.

In Chapter 13, Dwyer focuses on the importance of coastal and marine tourism in the IOR, with the emphasis being on the challenges faced by IORA Member States, along with the mechanisms to meet the various challenges through good governance practices. The specific aims of the chapter are: to provide an overview of coastal and marine tourism in the Indian Ocean; to identify the impacts of coastal and marine tourism in IORA countries; to identify challenges to the sustainable growth of coastal and marine tourism and the implications for different stakeholders; and to explore effective governance structures for sustainable coastal tourism.

The chapter thus analyses the economic environmental and social-cultural effects of coastal and marine tourism. While recognising the encouraging development towards increased tourism collaboration and governance processes amongst countries of the region, the author opines that significant challenges remain. There is, therefore, a need for a collective 'mind-set shift' in relation to the overall gains to be achieved through tourism, otherwise regional collaboration in the area of coastal and marine tourism will continue to be opportunistic and operate on a small scale.

In the final chapter of this section, Chapter 14, which deals with socio-economic benefits, Nowbuth, Rughoonundun and Khedun look at renewable ocean energies in the wake of climate change. The focus of this chapter is on clean renewable energy sources, such as wave energy, ocean thermal energy, osmotic power salinity gradients, marine current power, and tidal energy. This chapter provides 'a scientific flavour' with detailed descriptions of these latent technologies, which adds to our existing knowledge.

Sustainability, climate change, environmental protection and innovation

Section IV, the final section of the Handbook, consists of four chapters. This section emphasises the importance of: climate change and its impacts; marine and bio-resources in the Indian Ocean region; ocean health; the need for environmental sustainability; and the role of science and technology in reaping the benefits of the Blue Economy. It is argued that the vast marine and bio-resources in the Indian Ocean region may be optimally utilised by focussing on climate change, ocean

health, and technological innovations.

In Chapter 15, Colgan discusses aspects of the intersections between the Blue Economy and climate change that have received little attention to date. He highlights the major effects of climate change in coastal regions in general, but also emphasises that these will affect the Indian Ocean Region significantly, and for this reason Member States of IORA should be even more attentive to climate change in their Blue Economy strategies. The effects of ocean warming and the changes in ocean chemistry are manifold, and leads to increased precipitation and effects on the hydrological cycle of evaporation and weather patterns. Colgan uses a model of interaction between climate change and the Blue Economy in terms of four sectors: primary impact sectors, cross-cutting sectors, new sectors, and offshore minerals. This provides a solid analysis of the effect of climate change on tourism and recreation, marine construction, marine transportation and ship and boat building, and blue carbon trading in the Indian Ocean region.

The author argues that the resilience of SIDS in IORA needs to be increased by creating awareness of how the Blue Economy is shaped by climate change. IORA needs to centralise climate change in its Blue Economy policy framework and match this more aggressively with environmental sustainability.

Next, Obi, Okeyo, and Simelane focus on all aspects of marine and bio-resources in the IOR, in Chapter 16. This reflects the perceptions of economists and natural scientists and it thus fits well in the interdisciplinary context of the Blue Economy, as portrayed throughout this Handbook. Notably, the authors cover environmental threats as an impediment to a Blue Economy in IORA, in terms of threats to national living resources and ocean-based eco-tourism in the region. The inclusion of a discussion on sea ethics required to sustain the Blue Economy, is noteworthy. The chapter concludes that a key requirement for the optimal management of this unique but fragile ecosystem is the development of environmentally sensitive techniques for exploiting ocean resources, evolving a set of sea ethics, and containing the negative impacts of human activities on the ecosystem.

In Chapter 17, Obura focuses on the Blue Economy as a national goal, the importance and contribution of ocean health, and the incorporation of ocean health into economic and development planning. After emphasising the importance of the Blue Economy, along with the size of the Indian Ocean and its resource-rich character, the author deals exclusively with the importance and contribution of ocean health and the estimates of the value of ocean health at global and regional scales. Coral reefs, sustainable fisheries and ocean acidification (OA), along with the threat it poses to ocean health, are discussed in the third section of the chapter.

Obura then proceeds to determine how to incorporate ocean health into economic and development planning by citing the examples of South Africa and Seychelles. The chapter concludes that this is a unique time and opportunity for

IORA to take the lead in Blue Economy policy development.

In the last chapter of the Handbook (Chapter 18), Mohee, Somaroo, Uppiah, and Ragoobur focus on the need for environmental sustainability of the ocean economy, with reference to international initiatives on sustainable development, IORA, Samoa Pathway, African Union Agenda 2063, and the Mauritian Blue Economy in particular. The authors argue that identification of emerging ocean industries, capacity building and the pursuit of scientific research is needed to transform the Mauritian economy into a sustainable ocean economy. These attributes are also required for other Member States of IORA and it is therefore suggested that the Mauritian model for the ocean economy be shared in IORA.

Preliminary observations

The eighteen chapters of this Handbook provide unique perspectives – from the social sciences to the natural sciences - on a subject area that is gaining more traction daily. In the past few decades, it has become clear that, as the population of the world expands, humanity places more pressure on the Earth. Unfettered growth has caused immense damage to the land, and as humankind turns to the oceans for food, energy, and other resources, there is a danger that the damage will continue unabated, unless there is sufficient governance in this area. Thus, in all the chapters, the contributors acknowledge the importance of job creation and economic growth, but caution that exploitation of the oceans should be sustainable, hence the ‘Blue’ Economy. As mentioned throughout the Handbook, the Indian Ocean is particularly vulnerable to climate change, and therefore Goal 14 of the SDGs, and its priorities, should be pursued vigorously, in order to ensure a future in which poverty, inequality, and unemployment are addressed in ways that do not place our very existence at risk.

We trust that these first tentative steps towards understanding such a complex topic will provide a wide audience of stakeholders with a better picture of what the Blue Economy constitutes and how we can leverage on its strengths to build a better life for all.

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SECTION I

Context and Theory of the Blue Economy

CHAPTER 1

The Blue Economy and the Theory of Paradigm Shifts

Vishva Nath Attri

Introduction

There is no doubt that our oceans are important in preserving support systems on Earth. Oceans are essential to human life as they provide food security and income for hundreds of millions of people, and serve as a highway for global trade.

Growing enthusiasm around the globe about increasing revenue from the oceans has resulted in what could be referred to as the Maritime Century. The oceans' assets are worth \$24 trillion, and if they formed a country, the oceans would constitute the seventh largest economy on the planet. Oceans have the potential to deliver between \$400 billion and \$500 billion in dividends to humanity each year, provided that marine resources are not degraded to a critical level by human activity.¹ Deriving revenue from the oceans is risky, as it may exacerbate over-exploitation of the oceans' limited resources. We need the right approach, a balanced approach, which means: *focusing on sustainability and environmental protection whilst making optimal use of ocean resources.*

The Blue Economy is an interdisciplinary concept that is emerging as an alternative development paradigm. The main objectives of this chapter are: to explain the Blue Economy in terms of the Theory of Paradigm Shift developed by Thomas Kuhn² and to identify a critical mass of the Blue Economy that is capable of solving contemporary socio-economic problems at global, international, regional and local levels. The Blue Economy may be understood as our *perceptions* about oceans and our future – which greatly depends on sustainability and good governance of oceans through international and regional cooperation.

This chapter lays out an argument that supports theories that the concept of the Blue Economy is evolutionary and not revolutionary, as discussions of similar issues can be traced back to the 1950s. Based on current discourse, the Blue

Economy is essentially an advancement of the 'Green Economy' concept as a result of the fact that many small island developing states (SIDS) and coastal countries have questioned the concept of the 'Green Economy' and whether it applies to them and their efforts to promote a sustainable environment and a sustainable future.³

The RIO+20 United Nations Conference on Sustainable Development in 2012 has increased appreciation of the world's oceans and seas, and the need for more in-depth attention, collaboration and action. Advocacy for the Blue Economy has flowed from coastal to highland countries and it is widely recognised that oceans play a major role in the future of humanity. Most Blue Economy scholars and other stakeholders realise that this development paradigm is essentially a long-term phenomenon – involving theoretical as well as policy aspects. Governments are focusing on deliverable aspects of the Blue Economy, namely: eradication of poverty; employment generation; inclusive growth; gender equality; and sustainable development of economies, linking the Blue Economy with the United Nations Sustainable Development Goals (SDGs), and especially Goal 14.⁴

This chapter will argue below that the emerging development paradigm of the Blue Economy embraces the varied concepts of Ocean Economy, Green Economy, Coastal Economy and Marine Economy, and has great potential to stimulate higher and faster growth in gross domestic product (GDP) in the Indian Ocean region (IOR). Blue growth, which focuses on the long-term sustainability of oceans, has become a realistic policy frame within the Indian Ocean Rim Association (IORA) during the past few years, beginning in October 2014, and it has been recognised within the Association itself that the Blue Economy leads to improved human well-being and social equity as well as significantly reducing environmental risks and ecological scarcity.⁵

Concepts related to the Blue Economy

As stated above, the Blue Economy concept is being linked with the related concepts of Green Economy, Ocean Economy, Marine Economy, Coastal Economy and Circular Economy. In order to avoid confusion, let us draw distinctions between these concepts in the paragraphs to follow:

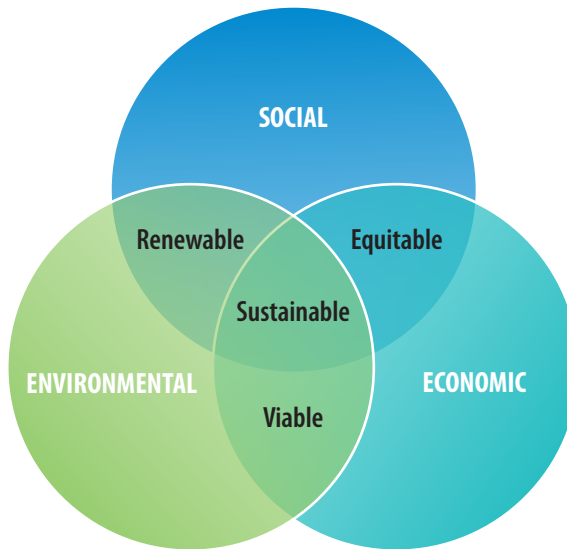
(a) The Green Economy

The Green Economy aims at reducing risks related to the environment and ecological scarcity. It pursues sustainable development that does not degrade the environment. The Green Economy is closely linked to ecological economics; but it also has a political application. According to Karl Burkart,⁶ the Green Economy

includes six sectors: i) renewable energy; ii) green buildings; iii) sustainable transport; iv) water management; v) waste management; and vi) land management. The 2011 UNEP Green Economy Report⁷ argues, ‘to be green, an economy must not only be efficient, but also fair. Fairness implies recognising global and country level equity dimensions, particularly in assuring a just transition to an economy that is low carbon, resource efficient, and socially inclusive’.

The Green Economy places emphasis on market regulations and restrictions that protect ecosystems and biodiversity. It has been criticised for its advocacy of price mechanisms to protect nature. According to the United Nations Environmental Program (UNEP), the Green Economy rests on three pillars, as shown in Figure 1.1.⁸ Social, economic and environmental factors interact, which translates into sustainability. Furthermore, the Green Economy needs to be equitable, viable and renewable.

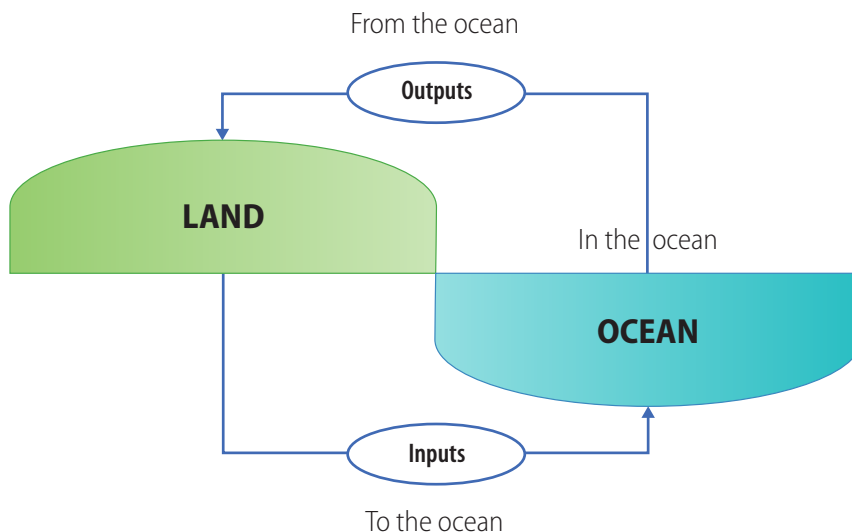
Figure 1.1: *The Three Pillars of Sustainability*⁹



(b) The Ocean Economy

The Ocean Economy is defined as encompassing economic activities related to the ocean, involving output from the ocean, and input to the ocean. To put it differently, the Ocean Economy can be defined as the economic activities that directly or indirectly take place in the ocean, use the ocean’s outputs, and put products into the ocean. Figure 1.2 below indicates the relationship between the ocean and the Ocean Economy.

Figure 1.2: *The relationship between the ocean and the Ocean Economy*¹⁰



(c) Marine Economy, Maritime Economy, Blue Growth and the Blue Economy

Maritime Economy is a term used by the European Union (EU), although it is now often referred to as the Blue Economy. It covers all the market related activities linked to the sea. It serves as an alternative model for sustainable development that places more emphasis on oceans. The Blue/ Maritime Economy is closely linked to the Green Economy concept and is of special interest to SIDS and coastal economies. Clearly consensus is lacking on a universal definition of Blue Economy. A working definition may include the following aspects, including but not limited to:

- i) re-framing the oceans as developmental spaces;
- ii) decoupling socio-economic development from environmental degradation;
- iii) improving relevant international law and governance mechanisms; and
- iv) prioritising the use of the seas to benefit people, alleviate poverty, generate employment and promote equity.

Yes, to date there is no unanimity in the definition of Blue Economy. The United Nations (UN) has tended to emphasise the marine related aspect of the Blue Economy, hence, accordingly, we may define Blue Economy as *marine-related economic development that leads to improved human well-being and social equity, while significantly reducing risks to the environment*.¹¹ The Blue Economy has also been understood by

some scholars as the extension of the Green Economy, focusing on the protection of the environment.¹² Suffice to say that the working definition in this chapter is that the Blue Economy focuses on seas and oceans, including but not limited to coastal areas, and the harnessing of their resources for sustainable economic development. This may focus on: human needs; ecosystem sustainability; a systemic approach; and sustainability standards which are related to environmental, social, ethical and food safety related issues.

(d) The Circular Economy

According to environmental economists Pearce and Turner¹³ a Circular Economy is an economy related to industries that promote greater resource productivity, with the objective of reducing waste and avoiding pollution - by design or intention. It has two types of material flow related to nutrients: biological and technical. These promote biosphere safety, ensure high-quality production, and are restorative and regenerative by design.

The Circular Economy (CE) differs from the Linear Economy. In linear economy, raw materials are used to make a product, after the production the waste is not used; whereas in the Circular Economy, raw materials are used for production and the waste is also recycled and is based on the efficient use of resources. As a generic notion, it draws from several more specific approaches, including cradle to cradle, biomimicry, industrial ecology, and the Blue Economy. This idea of circular material flows as a model was presented by Boulding as early as 1966.¹⁴ China promoted the idea of the Circular Economy in the Eleventh Five Year Plan, starting in 2006¹⁵ and movement toward the Circular Economy has remained strong in Europe since December 2012.¹⁶

The concept of Blue Economy came to increased prominence with the publication of Gunter Pauli's book *The Blue Economy*.¹⁷ As indicated above it is understood as a comprehensive term that embraces the Ocean Economy, the environment and sustainability. The concept has gained support as the best way to fulfil the human need for water, food, jobs and shelter. It focuses on creating 100 million jobs through 100 innovations within a decade. Emphasising the philosophy of resourcefulness, the Blue Economy model asserts that society can be converted to abundance by exploiting local resources.

Since the 1950s, studies on exploitation of resources have shown that there exists a disconnect between our culture and the over-utilisation of scarce resources. Pauli's work, however, has greatly influenced current thinking on business, the environment, social development and ethics.¹⁸

Recent developments in the Blue Economy

Since the turn of the Century there have been many theoretical and empirical studies on Maritime Economy and Ocean Economy.¹⁹ All these studies focus on the socio-economic contribution of the Ocean/Maritime Economy in various countries, including definitions, classifications, the accounting framework and related issues. These studies point out that economic activities related to the Blue Economy (which most refer to as the Ocean Economy) are developing significantly around the world.

Rising commodity prices and the development of new technologies have opened new realms of opportunity for the sustainable use of ocean resources. The European Commission recently adopted a new Action Plan for Innovation in the Blue Economy that will focus on using the resources of the ocean in a sustainable manner while driving growth and jobs in Europe.²⁰ The primary areas of focus of the EU action plan include: renewable energy – wind, waves, tides and biofuel; biotechnology; medicines and industrial enzymes; coastal and maritime tourism including cruise tourism and yachting; aquaculture including sustainable fishing, shellfish and marine plant farming; and mineral resources including gravel, zinc, sand, cobalt and copper.²¹

The EU is in the lead on several Blue Economy technologies, such as renewable energy and clean shipping, due to their investment in the Blue Economy paradigm as it is committed to creating a sustainable environment and a competitive edge. Further, the EU is focusing on innovation to ensure maximum sustainable yield (MSY) in fisheries. It has been implementing the 'European Strategy for Marine and Maritime Research' since 2008. The EU intends to achieve sustainable and inclusive growth in Europe by 2020.²²

The UNEP has published a report highlighting six case studies that reflect the diversity and flexibility of the Blue Economy concept; illustrate how economic indicators and development strategies can better reflect the real value of ocean benefits; and demonstrate practical applications that can be implemented at regional and country levels. In the foreword to the report, titled, *Blue Economy: Sharing Success Stories to Inspire Change*,²³ UNEP Executive Director, Achim Steiner, says, 'Ocean related issues are integral to most of the Sustainable Development Goals and to the transition towards the inclusive green economy'.²⁴

Red Ocean versus Blue Ocean management strategies

The imperatives for Red Ocean and Blue Ocean strategies are starkly different.

Table 1.1: *The Red Ocean versus Blue Ocean Strategy*²⁵

Red Ocean Strategy	Blue Ocean Strategy
Compete in existing market space	Create uncontested market space
Beat the competition	Make the competition irrelevant
Exploit existing demand	Create and capture new demand
Make the value/cost trade-off	Break the value/cost trade-off
Align the whole system of a company's activities with its strategic choice of differentiation <i>or</i> low cost	Align the whole system of a company's activities in pursuit of differentiation <i>and</i> low cost

With over-crowding in the market space, the prospect for profit and growth reduces; the products become commodities and cut-throat competition turns the ocean red.

In contrast to this, under Blue Ocean strategies, companies access untapped market space and create additional demand, and therefore have opportunities for highly profitable growth. With Blue Ocean, competition is not irrelevant, as imitation arises, but experience shows that a big window of opportunity exists to stay ahead of imitators. Thus the Blue Economy is emerging as an essential concept that 'injects' financial resources back into the local economy and offers higher quality products and services at a lower cost.²⁶ The concept of the Blue Economy encourages both public and private sectors to invest and to make use of emerging industries within the Blue Economy to ensure efficiency and promote strategic competitive advantage. Furthermore, the concept offers a wide platform that inspires younger generations to take innovative steps in creating employment opportunities and sparking entrepreneurial minds and technological advances to maximise opportunities.

Whilst grappling with definitional difficulties we need to ask ourselves why we need a Blue Economy approach: will this ensure sustainability? How much do we need to invest?

Developing a business model for the Blue Economy

Increasing disparities in the world have been attributed to rampant capitalism and accumulation of wealth. About two billion people are in the trap of extreme poverty and earn less than two dollars a day.²⁷ It is common cause that water, sanitation, and health amenities are lacking; that food security is a big issue and that

millions of youth are unemployed. It is clear that new business models should aim at resolving these challenges.

Thierry De Mees commenting on Pauli's Strategic Business Model for the Blue Economy²⁸ states that:

Prof. Gunter Pauli's statement "10 years, 100 innovations, 100 million jobs" is not an appeal to the governments, but to each of us. His methodology and strategy for designing business models based upon his Blue Economy paradigm is discussed here. When comparing this model to the classic problem solving models, we find a potential for an exponential improvement of strategic successes. The amazing rules that makes this model work are further analyzed.²⁹

On the basis of the above statement, we may conclude once more that the Blue Economy is a comprehensive business model as it includes sustainability and the environment.

Global contribution of the Blue Economy – an empirical investigation 2007–2012

The significance of the oceans in terms of providing millions of jobs through fisheries cannot be overlooked. The oceans also provide renewable wind, wave, tidal and ocean thermal energy. More than 90 per cent of world trade is carried by marine transport.

Table 1.2: *The Global Contribution of the Blue Economy: 2007–2012*³⁰

Variables	2007	2008	2009	2010	2011	2012
Establishments	1, 36, 501	1,39, 248 (2.012)	1,40, 025 (0.557)	1,42,986 (2.114)	1,45, 957 (2.077)	1,46,796 (0.574)
Employment	2,845,539	2,860,055 (0.50)	2,740,109 (-4.193)	2,738,948 (-0.042)	2,806,334 (2.460)	2,914,315 (3.847)
Wages	100,266,571,362	103,907,749,435 (3.694)	99,157,617,875 (-4.571)	100,496,527,241 (1.350)	106,128,663,956 (5.604)	112,882,861,957 (6.364)
GDP	293,811,323,451	332,169,527,961 (13.055)	278,971,423,585 (-16.015)	289,649,423,620 (3.827)	321,014,741,915 (10.828)	342,996,407,179 (6.847)
Wages/GDP Ratio *	34.12	31.28	35.54	34.69	33.06	32.91

As seen from the table above, the importance of the Blue Economy has increased in terms of its contribution to GDP. Except for 2009 the contribution of the Blue Economy in terms of wages, employment, and GDP increased during the last six years (2007–2012). The table also points out that blue growth strategy has the potential to create jobs and growth at global and regional level. Although the wage/GDP ratio has been erratic – suggesting less influence by the Blue Economy during this period – wages have increased consistently since 2010.

In terms of the Ocean Health Index³¹ marine jobs and wages component of the Blue Economy include: 1) commercial fishing; 2) mariculture; 3) tourism and recreation; 4) shipping and transportation; 5) whale watching; 6) ports and harbours; 7) ship and boat building; 8) renewable energy production (wind and wave); and 9) aquarium fishing. The total share of employment generated by the Blue Economy in 2013 was 8.9 per cent worldwide. Jobs created in the tourism sector were 266 million worldwide.³² The Blue Economy created: 58.3 million more jobs in fishing and aquaculture; 18.9 million jobs in fish farming; 18.4 million jobs in marine capture fisheries; and 21 million jobs in fresh water capture.³³

The Blue Economy and national income accounts

Since October 2014, IORA has made significant progress in adopting the Blue Economy as a strategy for sustainable development in the Indian Ocean region. Apart from emphasising ‘deliverable actions’ as was evident in core-group meetings on the Blue Economy, dialogues on the Blue Economy, and the First Ministerial Conference on the Blue Economy it has become increasingly clear that we need to evolve an accounting framework at national and regional levels.³⁴

Unlike other natural resources industries such as those associated with agriculture, mining, or forest resources, the oceans’ complex mixture of extractive resources, its influences on the lands in coastal regions, and the diversity of geographic circumstances ranging from islands to continents, make the measure of ocean economic values a particularly challenging proposition. These challenges are only enhanced by the different approaches to national economic data and income accounting undertaken by countries and the underlying national data systems upon which measurements must be built.³⁵

In light of the above, it is imperative that IORA member states begin their work on national accounting frameworks, so that the economic values of oceans and marine resources can be included in their national income accounts. China, USA, Canada, EU and PEMSEA (the Partnership for Environmental Management for the

Seas of South East Asia) have done good work in this regard.³⁶ Mauritius has begun to develop a national accounting framework, and other countries in the Indian Ocean Region may follow with the help of more experienced Dialogue Partners, especially China, Germany, USA and the UK.

IORA may follow the United Nations System of National Accounts (UNSNA), which has been adopted by IMF, The World Bank and the Organisation for Economic Co-operation and Development (OECD).³⁷ This system has been adopted by many countries with local modifications were needed. It is truly a formidable task for national economies to evolve the accounting frameworks necessary for evaluating the contribution of the Blue Economy to their GDP.

Kuhn's Theory of Paradigm Shift

In this section the Blue Economy is considered in terms of Thomas Kuhn's Theory of Paradigm Shift³⁸ and Imre Lakatos' Methodology of Scientific Research Programmes (MSRP).³⁹ The former, Kuhn, defined and popularised the concept of 'paradigm shift' in the 1960s.

Kuhn's Cycle

Change is inevitable, and has occurred for millions of years. The Kuhn Cycle is a simple cycle of progress preceded by a pre-science step and then involving five main steps:

1. Normal science, where the field has a scientific model of understanding (a paradigm) that works.
2. Model drift: Due to accumulation of anomalies the model cannot explain or solve existing problems.
3. Model crisis: Model drift leads to a crisis due to lack of confidence in the existing model. Attempts to patch up the model fail.
4. Model revolution: This begins when new alternative models emerge. It is a revolution because the new model is radically different from the old one.
5. Paradigm change: The existing paradigm is totally replaced by the 'new emerged paradigm'. The field changes from the old to the new paradigm. The new paradigm becomes new normal science and the Kuhn Cycle is complete.

Source: Compiled by the author from Kuhn, 1962

One concept is replaced by another. One way of thinking shifts to another. This does not happen spontaneously, but is effected by agents of change. These agents cause transformation in society through innovation. Gradually, traditional and old beliefs are replaced by new ones – this is what constitutes the process of a paradigm shift in science.

Kuhn uses the term paradigm to denote the realistic scientific successes discussed in his work. The paradigm refers to a cluster of issues, principles, methods and assumptions. This cluster is also presented as a disciplinary matrix. It consists of all the methods, theories, assumptions and analytical or evaluative frameworks applied by practitioners of the science. Those assumptions play a significant role when research is being conducted in a science or discipline. There is always a difference between the paradigm as a perception and the paradigm as a disciplinary matrix.⁴⁰ The ‘exemplar’ is a more comprehensive tool of analysis. The disciplinary matrix of the Blue Economy needs to be identified in order to constantly evolve the theory that is crucial to the success of the Blue Economy.

Lakatos’ Methodology of Scientific Research Programmes

Lakatos explains the theory of scientific change and its process with the help of the concept of ‘methodology of scientific research programmes’ (MSRP), which focuses on political experiences. He identifies two components of scientific theory:

- (i) ‘hard core’, which includes basic axioms, norms, and assumptions fundamental to the science; and
- (ii) ‘protective belt’, which protects or defends a set of ad hoc hypotheses.

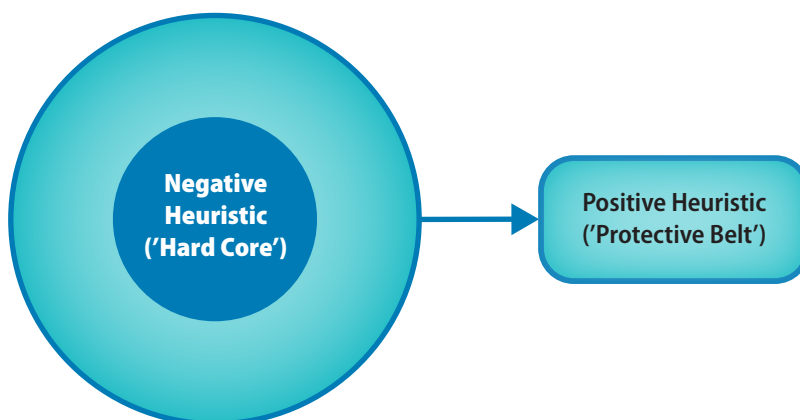
MSRP posits a series of theories that fall under the purview of scientific inquiry. Each successive theory represents advancement over its predecessor. Lakatos poses the question of progressiveness: How and when does a paradigm shift become progressive? We may postulate that the paradigm shift is progressive in two ways – either theoretically or empirically. The former implies the advancement of a new theoretical construct that has more predictive power or explanatory strength.

Thus, a research programme as a whole becomes progressive only when it moves forward in terms of theory and practice, which may be termed ‘theoretically programmed’ and ‘empirically progressive’. In fact, a movement from old theory to new theory must carry the weight of more explanatory power: its productive nature needs to be clearly confirmed. In the absence of clear confirmation of its more predictive power, the programme tends to be ‘degenerative’ and may be abandoned. Real scientific advancement takes place only when the scientist adopts progressive programmes. Degenerative programmes must be abandoned by the scientist.

In comparing Lakatos' methodology of scientific research programmes with Kuhn's theory of paradigm shift, Lakatos uses 'research programme' in place of Kuhn's 'paradigm'. A research programme is essentially a sequence of theories within the domain of scientific inquiry. The move from one theory to its successor within a research programme is called a 'paradigm shift'.

How does scientific knowledge 'progress' over time? In Lakatos' language, this is tantamount to asking, when is problem shifting progressive? It may be progressive in two ways: theoretically as well as empirically. Lakatos also talks about positive Heuristic and Negative Heuristic, which are shown in Figure 1.3 below.

Figure 1.3: *Positive Heuristic and Negative Heuristic*



Source: Author's own compilation

It is believed that the economic crisis of 2008 confounded economists. Their simulated economies betrayed their inability to tell us anything useful about the world. No computer model can explain or express the infinite complexity of an economy, even the smallest, simplest one. A consideration is whether the Blue Economy is able to explain the infinite complexity of our economy? An economy is a system in which people earn their living. It is related to production and the relations that make production possible. Thus, an economy is not money and it is also a mistake to understand it as economic financialisation. Rather, an economy exists to fulfil the needs of the people – both material and non-material needs. In the author's opinion, the Blue Economy is unable to explain the infinite complexity of our economy, as it is a *part* of an economy.

Is the Blue Economy a paradigm shift?

It is well established that the Blue Economy focuses on creating sustainable development based on ocean/ marine resources. It aims at: alleviating poverty and hunger; encouraging gender equality; creating 'blue jobs'; and harnessing the potential of the ocean in a sustainable manner. It can be seen as a new and still-developing phenomenon that posits a universal approach to sustaining the ocean's potential, which is critical for future generations. A paradigm shift toward global sustainability is essential and can be seen as the future investment paradigm.

'Hard' and 'soft' science are colloquial terms used to compare perceived methodological rigour, exactitude and objectivity in scientific fields. 'Hard' science is determined by the degree of empiricism applied, or the use of mathematics, experimentation, testable predictions, and extensive use of graphs, data generation, methodology and exactness. All natural sciences are 'hard' sciences. The social sciences are generally considered to be 'soft sciences' due to a lack of experimentation and other attributes of 'hard science'. The Blue Economy is an inter-disciplinary science and thus an exception to the traditional understanding of social sciences as well as natural sciences.

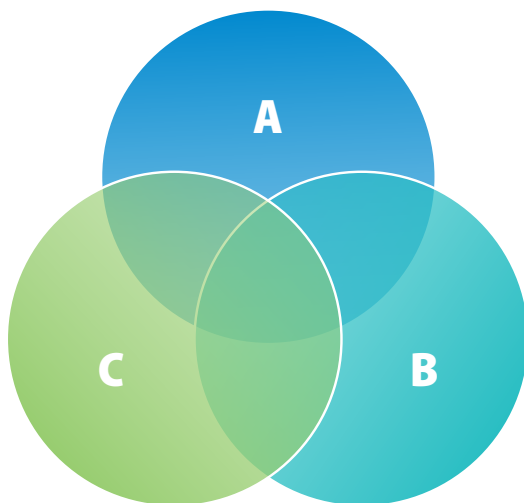
The 'hard core' of the Blue Economy is not easy to identify; but it is certain that in the next 100 years market mechanisms will remain to facilitate the allocation of resources, both on land and in the ocean. Humanity's greed may restrict the promise of the oceans ushering in a new era of inclusive growth and prosperity. Many economists, including John Maynard Keynes (in the 1930s), felt that if we grow four to eight times richer in the future, there will be no need to accumulate more material wealth.⁴¹ Consequently, the greed of humanity may end – and with it the aspiration in the world to accumulate further wealth. Today, we are many times richer than in the 1930s, but we have still not overcome our need to accumulate more material wealth. We can therefore safely hypothesise that greed will still be with us in 2050. Hence, it is difficult to say in terms of 'theory of paradigm shift' or 'methodology of scientific research programmes' (MSRP) whether the Blue Economy is a 'paradigm shift' in the real sense of the word.

However, the thinking of many scholars – that the market economy is unable to deliver to the poor due to the limited success of 'trickle-down economics' in overcoming basic challenges – seems to be correct. The Blue Economy analyses real opportunities in a different way by evolving new business models. However, is it indeed a 'paradigm shift'? Does it fully explain the real world? These pressing questions need to be answered.

Having discussed the theory of paradigm shift and its links to the Blue Economy above, let us now explain the concept of the Blue Economy with the help of a Venn

diagram that indicates possible relationships between finite collections of different variables. This technique can be applied to understand the interconnectedness between the three pillars of the Blue Economy (Figure 1.4).

Figure 1.4: *The Three Pillars of the Blue Economy*



Source: Author's own compilation

A, B and C represent the ocean economy, sustainability, and the environment (see below).

Figure 1.5: *Relationship among Ocean Economy, Sustainability and Environment*

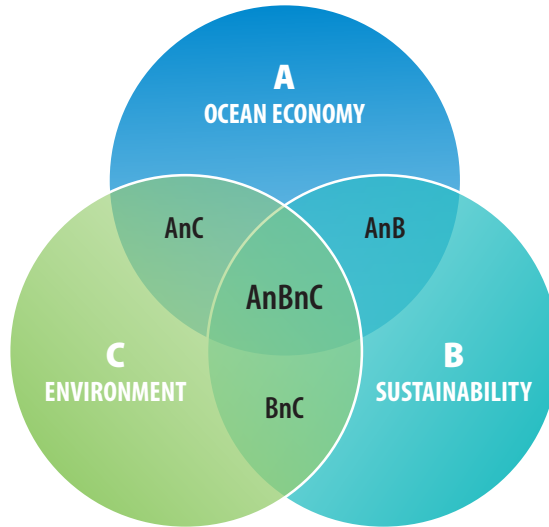


Source: Author's own compilation

Let us now overlap three separate Venn's diagrams into one, a critical mass that is capable of generating infinite criteria for blue growth at global level, regional level and country level. The area indicated by A union B union C ($A \cup B \cup C$), is the Blue Economy; it includes some 'sustainability' and 'environmental' elements shown by the 'B' and 'C' diagrams. This 'critical mass' of the Blue Economy has been universally accepted as bringing sustainable and inclusive growth across the world; despite the lack of a widely accepted definition of Blue Economy. This definition

may evolve over time, but as policy makers we should place more emphasis on policy to solve the food scarcity and unemployment rates faced by most of the countries in the Indian Ocean region (IOR).

Figure 1.6: *Interaction of Ocean Economy, Sustainability and Environment: Blue Economy*



Source: Author's own compilation

Clearly, the Blue Economy needs to be managed in innovative ways. The ocean is a rich source of prosperity for the global economy. Presently, industrial use of the ocean is on the rise: movement of goods by ships; as well as new oil and gas developments far out at sea; and proposals for extracting minerals from the sea floor and the high seas. On-going research now makes it clear that healthy ocean ecosystems also contribute to the global economy. Thus, the decline in ocean ecology needs to be checked as a matter of urgency.

Principles and characteristics of the Blue Economy

Existing and ongoing studies of the Blue Economy, as illustrated in this Handbook, are developing principles applicable to the development of the ocean as a whole, or any of its parts, to ensure prosperity, resilience and convergence between short-term and long-term objectives. These principles are universal in nature and their application will help to achieve a sustainable economy. They may be used by all stakeholders in the Blue Economy. The 21 principles of the Blue Economy are as follows:

1. Respond to basic needs with what you have, introducing innovations inspired by nature, generating multiple benefits, including jobs and social capital, offering more with less.
2. Solutions are first and foremost based on physics. Deciding factors are pressure and temperature as found on site.
3. Substitute something with nothing – question any resource regarding its necessity for production.
4. Natural systems cascade nutrients, matter and energy – waste does not exist. Any by-product is the source for a new product.
5. Nature evolved from a few species into a rich biodiversity. Wealth means diversity. Industrial standardisation is the opposite.
6. Nature provides room for entrepreneurs who do more with less. Nature runs counter to monopolisation.
7. Gravity is the main source of energy. Solar energy is the second renewable fuel.
8. Water is the primary solvent (no complex, chemical or toxic catalysts).
9. In nature, the constant is change. Innovations take place at every moment.
10. Nature only works with what is available locally. Sustainable business evolves with respect not only for local resources, but also for culture and tradition.
11. Nature responds to basic needs and then evolves from sufficiency to abundance. The present economic model relies on scarcity as a basis for production and consumption.
12. Natural systems are non-linear.
13. In nature, everything is biodegradable – it is just a matter of time.
14. In natural systems, everything is connected and evolving towards symbiosis.
15. In nature, water, air and soil are the commons: free and abundant.
16. In nature, one process generates multiple benefits.
17. Natural systems share risks. Any risk is a motivator for innovations.
18. Nature is efficient. So sustainable business maximises use of available material and energy, which reduces the unit price for the consumer.
19. Nature searches for the optimum for all involucre elements.
20. In nature, negatives are converted into positives. Problems are opportunities.
21. Nature searches for economies of scope. One natural innovation carries various benefits for all.

Source: 21 Principles of the Blue Economy⁴²

In addition to this, on the basis of the various reports published by United Nations Environment Program (UNEP), International Maritime Organisation (IMO), and

Food and Agriculture Organisation (FAO) and other related organisations,⁴³ the following attributes of the Blue Economy could be distilled:⁴⁴

1. It is a sustainable economy.
2. It includes market values of the ocean's ecosystems.
3. It embraces non-market marine values.
4. Thoughts from thinkers and doers promote transitioning to a Blue Economy.
5. It fills the gaps between water demand and supply.
6. It promotes marine spatial planning (MSP), in order to help face the increasing pressure on the seas.
7. It focuses more on marine resources for SIDS and coastal states.
8. It promotes national equity – including gender equity.
9. It generates inclusive growth and good jobs for all.
10. It develops seas and oceans beyond national jurisdiction.
11. It refines international governance mechanisms and promotes seabed development.
12. It optimises the benefits received from the development of SIDS, coastal, developing, and developed countries' marine environments (through fisheries agreements, bioprospecting, and oil and mineral extraction).

Maritime security, Blue Economy and ocean governance: the linkages

The Blue Economy and maritime safety and security are closely inter-linked, and there should not be any controversy among scholars as to which comes first. In fact, linkages between the two are simultaneous; and both of these need to be addressed at the same time. Good governance is common and relevant to both maritime security and the Blue Economy, as it helps ensure coordination of ocean-economy sectors as well as jurisdictional and transboundary issues. Efficient coordination is needed at national, regional and global levels and strategies, laws and action could be aligned or coordinated, which will ensure better implementation of the Blue Economy.

Secondly, international cooperation in maritime safety and security and the Blue Economy can be increased through better understanding of the seas, as well as information sharing among stakeholders – governments, the private and public sector, as well as civil society. Innovations and surveillance technologies are also important for meeting the challenges of the Blue Economy. The main challenge is to build trust and confidence, so that everyone is willing to share.

Thirdly, knowledge, law and strategy play an important role if these lead to action. Without enforcement, good law is irrelevant and meaningless. The complex nature of maritime security requires working towards joint inter-agency,

inter-state enforcement, and the prosecution of coastal crimes and crimes at sea.

Finally, we know that capacity building in many states is very weak in relation to ocean governance; hence, collaborative and cooperative efforts need to be undertaken for capacity building in this field.

This should not be considered as knowledge-and-technology transfer from the North or West to the South. Even some developed states and international organisations may be lacking in knowledge and technology in this regard. Therefore, dialogue on the joint and collective learning process can be undertaken simultaneously and without any reservation or preferences of North or South, East or West. We need to move collectively in ensuring good governance and efficient linkages between maritime security and the Blue Economy.

IORA and the Blue Economy

In view of the vast employment generation potential of the Blue Economy in fishing and aquaculture, as well as the tourism industry, amongst others, IORA adopted the Blue Economy as a short- and medium-term strategy for achieving sustainable development in the region through strengthening regional cooperation. The Council of Ministers' Meeting, held on 6 to 9 October 2014, in Perth, Australia, adopted the Blue Economy as the top priority for generating employment and ensuring sustainability in business and economic models.⁴⁵ The IORA Secretariat draft paper identified eight priority areas for cooperation in the Blue Economy: Fisheries and Aquaculture; Renewable Ocean Energy; Seaports and Shipping; Seabed Exploration and Minerals; Marine Biotechnology, Research and Development; Tourism; Ocean Knowledge Clusters; SIDS and lesser developed countries (LDCs).⁴⁶

In a nutshell, the initiatives undertaken by IORA should aim to: promote and enable the latest digital technologies; create a conducive environment for ensuring more growth and development of ocean resources, such as ocean renewable energy, deep sea mining, shipping, and port management. We should also focus on mitigating the impact of climate change and human pressure on the oceans. Good governance of the oceans is the *sine qua non* of the ocean's health and productivity. For this, IORA should undertake joint programmes of realistic interdisciplinary projects to promote technical and human capacity building.

Within IORA, Mauritius and Seychelles have made very good progress as SIDS. In Mauritius, the Ocean Economy (Blue Economy) has been identified as one of the pillars of its economic development – leading to its transformation into a high-income economy by 2025. At present, the Blue Economy contributes to around 10 to 11 per cent of its GDP.⁴⁷ In the Seychelles, there is a Ministry of Finance, Trade and Blue Economy. A budget of SCR796 480 879 (USD\$58 845 066.66)

was approved by the government in December 2016 for the year 2017.⁴⁸ Learning from good practices followed by Mauritius and the Seychelles, we could develop a mechanism for financing of the Blue Economy within IORA. However, innovative thinking on all these questions needs to be continued. A joint accounting framework, as well as study groups, could be constituted for developing national accounting frameworks.

In order to reap the benefits of the Blue Economy in IORA, which is a diverse group of developed, developing, small island developing states, and least developed countries, having high and low levels of per capita income, GDP growth rates, sectoral development, infrastructure development, and social development, we need to have well-designed, comprehensive, and inclusive policy frameworks for the sustainable development of the Blue Economy. The blueprint of such a policy is evident in the recommendations of the First IORA Ministerial Blue Economy Conference held in 2015,⁴⁹ and the Second Ministerial Conference convened in 2017⁵⁰ to evolve and adopt a strategic framework for strengthening Blue Economy architecture at regional level.

Conclusion

The Blue Economy offers vast opportunities as well as challenges at individual country level, at regional level, and globally. In this chapter, an attempt has been made to discuss most of the aspects of the Blue Economy, both at policy level (as emphasised by governments) as well as at academic level. It has been established that the Blue Economy is essentially an evolutionary and long-term concept and that its benefits largely depend on the theories still to be developed by scholars in the field.

The Blue Economy may or may not be a paradigm shift. It depends on the occurrence of favourable developments in the future. The 'market mechanism' for allocations of ocean/ marine resources that will optimise the gains of the Blue Economy is yet to be evolved. Although the market mechanism has been criticised by most scholars, no alternative has been proposed to replace it. As a result, innovative business models need to be developed under the Blue Economy, which would hopefully lead to inclusive growth. Many necessary and sufficient conditions need to be developed for the Blue Economy to be understood as a paradigm shift.

The principles of the Blue Economy are aimed at economic development of the ocean, which contributes to prosperity and resilience. These principles provide a platform for the development of a Blue Economy that is inclusive and sustainable as well as universal. It may be applied to part or whole of the oceans, seas, and coasts; to traditional and emerging sectors; public and private sectors, financial sectors; and to national and international stakeholders.

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CHAPTER 2

The Blue Economy

Theory and Strategy

Charles S. Colgan

Introduction

The term Blue Economy has spread rapidly around the world. It is used to describe an integrated approach to economic development and environmental sustainability that is based on the resources of oceans and coasts. Nations have rather suddenly taken note of the large geographic areas in the form of exclusive economic zones (EEZs) over which they have jurisdiction and begun developing strategies for using these areas. Many attribute this sudden attention on ocean resources and environmental issues to the discussions that took place in 2012 at the United Nations, which both defined an overall vision for sustainable futures and identified specific goals, including those specific to the oceans.^{1,2,3}

This global attention to the Blue Economy has been matched at the national level. Blue Economy policy papers are in various stages of evolution in countries around the world, including many in the Indian Ocean region. Blue Economy strategies have been developed or are under discussion in India,⁴ Bangladesh,⁵ Australia,⁶ Indonesia,⁷ Mauritius,⁸ Seychelles,⁹ East Africa¹⁰ and South Africa.¹¹ All these documents draw attention to the unique resources and features of each country or region, but there is a common set of themes in all of these discussions focusing on the economic opportunities to be seized while acknowledging the environmental limitations within which development must take place.

These documents may best be described as efforts at awareness building. They are all likely to be effective at encouraging leaders in the public, private, and non-governmental sectors to pay attention to the opportunities and challenges of the Blue Economy, but there are relatively few papers on the Blue Economy that speak to the practicalities of what specific strategies will be needed to direct actions. Persuading people to act is not the same thing as deciding what action to take.

The fundamental challenge of the Blue Economy is to simultaneously do more and less. The Blue Economy should increase the wealth that a nation derives from its ocean and coastal resources. But to do this, the nation may need to do less of many of the things it is already doing. Increased wealth in fisheries may require reducing fishing to biologically sustainable levels. Exploiting hydrocarbon and mineral resources may increase wealth today, but the effects may be only temporary if portions of the mineral wealth are not saved for the future. The Blue Economy is both a bold vision and an excruciatingly delicate balancing act.

This paper proposes a strategic framework and set of specific strategies to transform the Blue Economy idea from goal to action in ways that make it more likely that the appropriate balance will be struck among goals that are both complementary and competing. The framework is independent of economic sector, resource, or region. Its implementation will rest in the hands of multi-national, national and sub-national institutions, which will be responsible for adapting the general strategies to actions to be taken at specific times and places. There are five elements to the framework: (1) Investment, (2) Customers, (3) Management, (4) Innovation and (5) Measurement.

The essential feature of the Blue Economy is that all the elements must be addressed simultaneously, although the level of effort devoted to each will vary, as local circumstances require. The following sections describe each of the elements.

Investment

Investment is the link between the present and the future. It is the deferral of current income (savings) that is then converted into productive use to create new economic values. These values provide returns to the investor and gains to the overall economy. Deciding to forego current consumption for future gain is the fundamental economic process by which restraint and gains are balanced. Capital is the term used, rather ambiguously, for both the pool of savings used to make the investment and the results of that investment.

Standard economic models focus on using *financial* capital (the pool of savings) to create *physical* capital (the result of investment). Shaping the Blue Economy begins with these types of investment, but recognises that they are insufficient to meet the twin goals of increased wealth and sustainability. In order for those goals to be met, investment in *natural* capital and *human* capital is needed.

The physical capital of the Blue Economy is well known: ports and harbours; ships and boats, as well as the dry docks and cranes needed to build and use them; facilities for tourists such as hotels; research and education facilities related to the oceans; and many other types of structures and equipment needed for producing

goods and services. Physical capital may be created and owned by the public sector or the private sector or a mix of the two. Publicly provided physical capital for public goods (whose benefits extend beyond those who make the investment) is often referred to as 'infrastructure', though the line between infrastructure and other types of capital is not necessarily a bright one.

Deployment of additional physical capital is a pre-condition to expanding the Blue Economy, but there are limitations on the amount of physical capital that can be deployed. The most obvious is financial capital, which is a severe limitation in the lower and middle-income countries that characterise the Indian Ocean region. Other limits come from the losses of natural capital, which may be incurred by investments in physical capital. For example, extensive shoreline development for port or tourist purposes may destroy wetlands essential for fisheries habitat, shoreline protection, or recreation.

Still other limits may be placed by decisions about the mix of physical and human capital to be deployed. This may be a particularly difficult problem in fisheries. Expanding output in fisheries can most easily be done by using larger boats and more efficient methods, so that fewer people can catch more fish. But this can result in overcapitalising the fishery to the point where the stock of capital is capable of removing fish faster than they can be replaced through natural processes. The outcome in such fisheries is sometimes buyback programmes that take capital out of the fishing industry to reduce catch and biological pressures.¹² Alternatively, many small-scale fisheries that support families or rural communities employ very little capital and are highly inefficient in terms of output per unit of labour. But that inefficiency reduces pressure on fish stocks while increasing employment opportunities that are at low income levels but are critical to community stability.¹³

Financial capital remains the largest limit on investment in the Blue Economy in most of the nations of the Indian Ocean region. Low national incomes offer few opportunities to create the pools of savings that are needed to make either public or private investment. This puts pressure on Blue Economy development to lean towards high financial return investments. Access to world capital markets is available for some projects, but these must provide world market-level returns to attract this capital. As a result, the region is still heavily reliant on international development aid from the United Nations (UN), the World Bank, the regional development banks, and nationally based aid programmes.

The limitations on capital availability in the Indian Ocean region are ameliorated to a significant (but far from complete) extent by the availability of international development finance. An array of international development financial institutions provide assistance to countries in the Indian Ocean region, including the World Bank, the Asian and African Development Banks (including the Africa Development Fund), and the Islamic Development Bank.¹⁴ Different types of assistance are

offered to reduce debt - primarily loans and concessionary loans, but also refinancing. International development finance (or 'Official Development Assistance' or ODA) is used for a variety of purposes, including support for public services and facilities, as well as supplementing private investment capital. All could be useful to the Blue Economy. The World Bank, in particular, has identified the Blue Economy as a strategic priority and is devoting significant attention to supporting related activities in both the economy and the environment.¹⁵

The bulk of ODA is loans of various types, which are offered on favourable terms, but which also create risks of high levels of debt that can become a barrier to development. Table 2.1 shows total ODA receipts, the per capita gross national income (GNI) and the per cent of GNI comprised by ODA for nations in the Indian Ocean region.¹⁶ ODA varies substantially among the countries in the US region, but some countries have high percentages of their economy consisting of ODA (Madagascar, Mozambique, and Tanzania).

Table 2.1: *Official Development Assistance in the IORA Region: 2015*¹⁷

Country	Net ODA Receipts, 2015 (USD million)	GNI/CAP, 2015 (USD)	ODA/GNI, 2015 (%)
Bangladesh	2 570	1 190	1.24
India	3 163	1 590	0.15
Indonesia	- 43	3 440	-0.01
Kenya	2 474	1 340	3.93
Madagascar	677	420	7.05
Malaysia	- 1	10 570	-0.00
Maldives	27	6 670	0.95
Mauritius	77	9 610	0.67
Mozambique	1 815	580	12.55
Pakistan	3 790	1 440	1.32
Seychelles	7	14 760	0.50
South Africa	1 421	6 050	0.47
Sri Lanka	427	3 800	0.53
Tanzania	2 580	910	5.85
Thailand	59	5 620	0.02

The supply of financial capital will always be less than the demand, and the challenges of overstrained debt set limits on the transition speed to the Blue Economy, but capital markets are constantly evolving: several recent finance innovations make connections between the economy and the environment that could be particularly valuable for the Blue Economy. One is the creation of 'debt-for-nature' swaps where commitments of lands and waters for conservation purposes are paid for by restructuring parts of a nation's external debt, with the savings from the restructuring being used for a variety of conservation purposes. Two pioneering debt-for-nature swaps occurred in the Indian Ocean region. One involved The Nature Conservancy and the Seychelles¹⁸ and the other involved the World Wildlife Fund and Madagascar.¹⁹ Debt-for-nature swaps are a subset of a larger evolution in capital markets called impact investment. Impact investing also takes the form of green bonds, where debt instruments (bonds) are designed to provide both financial returns and measurable impacts on the environment.^{20,21,22}

Impact investing provides a bridge between financial capital, physical capital, and natural capital. Natural capital is an economic expression of the value of nature and the environment. As with other types of capital, nature and environment are seen as comprising a stock from which flow goods and services that are valued by people. The goods stock comprises both non-renewable assets such as minerals (hydrocarbons, metallic, and aggregates such as sand) and renewable assets such as fisheries and, increasingly, energy.

The services from nature are described as ecosystem services,^{23,24,25} and the measurement of the economic value of these services is a rapidly evolving field in the Blue Economy. Ecosystem services valuation and the measurement of natural capital are widely recognised as being critical to the Blue Economy, but the methodological and data collection issues associated with reliably measuring natural capital are an important limitation. This greatly increases the need for attention to be given to developing the relevant data as part of the measurement tasks described below.

The fourth capital element is human capital, which comprises the knowledge, skills, and abilities of the workforce. Attention to human capital in the Blue Economy is required in part to provide competitive advantage and in part to meet distributional goals associated with sustainable development strategies. Human capital is an essential element in all sectors of the Blue Economy, from the subsistence fisherman in coastal Bangladesh to the master mariner guiding a super-tanker through the Arabian Gulf. Income gains for workers and communities depend on the expansion of Blue Economy activity, but also on expanding the skilled workforce. Employees in the tourism and recreation sector are an obvious example: the skills necessary to provide high quality services to visitors are an essential element in establishing competitive advantage. But skills and

knowledge are also critical in the fisheries, and will likely need to change, perhaps significantly, in order to change fishing practices in order to reach sustainable harvesting levels.

The first element in a Blue Economy strategy is, therefore, a capital investment strategy that: identifies the physical capital (buildings, equipment, infrastructure, etc.) needed; assembles the financial capital; makes appropriate investments in human capital; and takes steps to either increase or avoid diminishing the natural capital. The choices regarding capital will depend on an understanding of how the return on each type of capital is measured, which is the final element of the Blue Economy strategy discussed below. Investment strategies, as defined here, are also the key path to the sustainability of the Blue Economy.

‘Sustainability’ is a term, like Blue Economy, that has no universally accepted precise definition, but is widely understood in a general sense. Sustainability has been described, in perhaps the most widely quoted source, as the ability to ‘meet the needs of the present without compromising the ability of future generations to meet their needs’.²⁶ The returns to financial investment in physical capital (for which economists use the general term ‘interest’) allow for expanded resources to meet current and future needs over the life of the physical capital.

The other aspect of sustainability that is widely accepted is the tripartite nature of sustainability: economic, environmental and social.²⁷ These ‘three pillars’ are addressed by considering investments in physical, natural, and human capital. As with the returns to physical capital, the returns to natural capital take the form of constant or increasing environmental resources and ecosystem services plus increasing returns (in the form of incomes) to labour. The investment strategy and the position of each nation in terms of net ocean product, as defined below, determine how sustainability can be achieved on all three dimensions.

Consumers

All the studies, policy papers, and presentations on the Blue Economy focus relentlessly on the production side of the economy: how much is or could be produced now and in the future. Little attention is paid to the other side of the transaction: the consumers of the goods and services of the Blue Economy. This is understandable to an extent, as the Blue Economy is seen largely in terms of sectors and industries and their contribution to the national or regional GDP. But an understanding of the consumers of the Blue Economy is just as important, in part to identify consumers most likely to support growth in the Blue Economy, and in part to be sure that the Blue Economy is capable of adjusting to changes in consumer income, taste and preferences.

A good example of how knowledge of the consumer is important is found in the tourism and recreation sector, specifically in the advent of the cruise ship market in the Indian Ocean. This is a rapidly growing sector in several countries within the Indian Ocean region including traditional tourist destinations such as the Seychelles and Mauritius as well as new cruise destinations in Bangladesh, India, and east Africa.^{28,29,30,31} Most of the discussion about the growth in cruise ships has been on the problems of providing adequate infrastructure to support the industry, managing environmental impacts, and the local economic impacts from cruise passenger spending.

Less attention is paid to what the rise in cruise ships as a vehicle for coastal tourism means for the market for tourism and how the land-based suppliers of tourism services need to respond. Cruise ships offer several important features to a large segment of the tourism market. Among these are very consistent and high quality service with well-trained personnel and an opportunity to have a number of different experiences in a very convenient and highly organised way. Cruising also offers the experience at a variety of price points, although the marketing approach regularly encourages customers to spend more through 'upgrades'.

These characteristics (high quality, consistency, convenience, and access through different prices) are all replicable in the land-based tourism industry, but it is much more difficult on land. Cruise ships have one other critical advantage: a single organisation managing almost every aspect of the experience. Cruise lines hire and train their own staff to their own specifications. They operate the hotel, restaurant, and entertainment. And they organise and vet onshore firms that support land-based services to their customers. In contrast, land-based ocean tourism services are provided by a number of different organisations with different standards for services, different approaches to managing key personnel, and often minimal capacity to organise the entire experience. Nothing prevents land-based tourist organisations from providing the same types and level of service but the levels of inertia and the transactional costs of doing so are real barriers.

There are other ways to deliver tourist experiences, such as 'adventure tourism'. This differs radically from the cruise ship approach, and national ocean-tourism development strategies must recognise a diversity of tourism customers. But understanding the rise of the cruise ship industry as an issue – serving a large number of customers willing to pay relatively high prices for a particular type of experience – changes the perspective on tourism development strategies, from providing infrastructure to organising the land-based industry to be competitive in this large and growing market.

The cruise ship example is one of understanding the current customer base and developing strategies to adjust to it. But attention to customers is most important in identifying how customers are, or may, change. An example may be seen in

fisheries. Nations pay attention to the issues of harvesting in a sustainable manner, in many cases by reducing catch, and potentially incomes. The only way to offset this is to increase the prices paid for fish at the harvester level, which requires that the ultimate consumers of fish must be willing to pay higher prices. Scarcity resulting from reduced catch will do some of the work, but the highly competitive global seafood business means that scarcity may simply attract imports that undercut domestic fisheries, frustrating the development/sustainability Blue Economy goals.

The question then becomes: Can consumers pay higher prices for fish, and why would they do so even if they could? Consumers will be able to pay higher prices for fish as incomes rise if fish are transformed from an inferior good (consumption is high when income is low) to a normal good (consumption rises with income). Higher income is a targeted outcome of Blue Economy development, so strategies that raise income in other parts of the Blue Economy (and the economy as a whole) may provide the means to shift from lower value fish products to higher value fish, such as processed fish. Exports to higher income regions are another opportunity to raise income, if the consumer demands in the higher income country can be met. In many countries, fish that can be certified as having been 'sustainably caught' command a higher price. The need to provide a higher quality product, in order to raise income, then translates back into capital investment strategies involving all four types of capital identified above.

Attention to the characteristics of customers and the factors driving changes in those characteristics is an essential part of a Blue Economy strategy because it helps guide investment strategies and maintains competitiveness in the global Blue Economy. It reminds managers that their decisions about how to develop the Blue Economy are subject to market tests that will ultimately determine the economic success or failure of each country's Blue Economy.

Management

The ultimate success of efforts to create a Blue Economy that embodies the twin goals of economic development and sustainability depends on the management decisions of institutions in the public, private, and non-governmental sectors. Key management decisions are taken in the investment decisions discussed above, but investment is just the start of the process.

Private sector management decisions are well understood in broad outline. The task is to supply goods and services, and to address customer service, transportation and logistics, human resources and production processes. The decisions taken will depend on the industry, the economic conditions, and the skill of the managers. Discussions on management tasks such as these typically take place in the context

of large organisations, but the same management problems apply to any business of any size, and small enterprises are generally much more typical of Blue Economy industries – with a few exceptions such as ship building and marine transportation. Addressing the need for small firms to better understand management principles and processes will be a challenge throughout the Indian Ocean region.

Many of the most important management challenges, however, are to be found in the public sector. Like the private sector, the public sector, varying in structure and size across the countries of the region, must pay attention to the management of organisations in much the same way as private organisations. But the public sector is also responsible for addressing the issues that the private sector cannot address or can only address inefficiently.

At the top of this list is providing the safety and security services that are essential to the functioning of any economy, but which are very difficult in the marine setting. The extension of national jurisdictions permitted under the UN Convention on the Law of the Sea that created the exclusive economic zones (EEZs) also created a massive security problem for every nation. The total EEZs of the region exceed 26.7 million square kilometres, or 38 per cent of the entire Indian Ocean.³² Declaring this area as within national jurisdiction is not the same as assuring the enforcement of national laws. Particular security challenges in the region relate to piracy in the north-western part of the region, and to illegal fishing throughout the area.

The other public sector challenge is the management of the environmental and other natural resources of the Indian Ocean. This includes marine resources such as minerals beyond national jurisdiction, where international institutions such as the Deep Seabed Mining Authority have responsibility, or where cooperation among nations is required, as with highly migratory fish species such as tuna. But the bulk of the environmental management falls to nations.

The essential task in environmental management is to set limits. Limits are set on: emissions into the air and water; on the land or sea space where uses will be encouraged, discouraged, or prohibited; and on the quantity of resources that can be removed from the oceans or coasts. The resource management task comprises three phases:

- Determination of the appropriate limits. Limits may be defined by spatial restrictions or permissions, such as, for example, marine protected areas, marine spatial plans, and coastal zone management programmes.³³ Limits may also be imposed on what can be put into the environment (emissions limits) or taken out (mining restrictions).
- The policy structure to require or encourage actions that stay within the limits. Such structures can be regulation (prohibitions on exceeding the limits) or incentives (encouragement of staying within the limits) or some combination of

the two approaches (such as cap and trade rules on emissions or catch-share arrangements for fishing).

- Enforcement of limits, which may be through self-reporting, technology-based monitoring, and/or through law enforcement organisations.

Two policy frameworks are particularly important for resource and environmental management relevant to the Blue Economy. One is integrated coastal zone management (ICZM), an approach that originated in the 1960s.³⁴ ICZM rests on the principle that coastal areas are unique regions because of the interaction of terrestrial, estuarine, and marine ecosystems with large concentrations of human populations. The other, more recent framework is marine spatial planning (MSP) and one of the key ideas emerging from MSP, marine protected areas.^{35,36,37} These policies are all based on the setting of limits on human activity and spatial arrangements of ecosystems.

The essential ingredients in successful management are information, coordination, and participation. The information needed to set appropriate limits for sustainability is substantial: sufficient physical and biological information on the functioning of natural systems is rarely available, even in highly developed countries. The quantity and quality of scientific data and information is highly variable across the Indian Ocean region. Though these are steadily improving over time, decisions will often be based on limited information and uncertainty. But this is normal when managing complex interaction between social and natural processes. So much so that a specialised field, adaptive management, has arisen to guide decision processes.³⁸

The second element of management is coordination. Successful development of the Blue Economy requires a closely coordinated set of efforts within and across sectors. In most organisations, the tasks of development, human resources, and environmental management are separated. Each part operates within its own sphere, until a specific problem requires interaction across the organisation. In other words, coordination is only part of the routine occasionally and special effort is needed to make it happen. The problem is exacerbated when coordination is required across organisational boundaries, or, for example, between levels of government, or between public and private sectors. But the essential characteristic of the Blue Economy is that of an organic whole built from its individual parts in a continuing process.

This process must include both those who set the limits and those who must abide by them. The third management element is, therefore, participation. A large body of evidence supports the principle that limits are much more likely to be accepted and observed if all 'stakeholders' participate in the process of establishing the limits – from the conduct of scientific research³⁹ through to the adoption of

the limits and their periodic review and update.⁴⁰ Participation in the design of limits has been shown to be critical in both less developed and highly developed countries.⁴¹

Innovation

The aspect of the Blue Economy that has the greatest appeal to policy makers in high-income countries is the possibility of developing and deploying a wide range of innovative products and services based on ocean resources. The ‘innovative’ Blue Economy has been highlighted in Europe, Canada, and the United States.^{42,43,44} Technological innovation is emphasised in fields such as information and communication technologies (the development of ocean observing systems),⁴⁵ the development of technologies for deep seabed mining,⁴⁶ the generation of renewable energy,⁴⁷ and in the use of biological materials from the oceans in the development of new pharmaceuticals.⁴⁸ All of these possibilities are also relevant to lower income countries, but the capacity for leading the research and development processes needed to create and deploy new ocean technologies is much smaller in lower income countries.

These and other examples of new technologies for oceans can be expected to transform the Blue Economy over several decades. The technologies and their associated industries are barely reflected in national definitions of ocean-related economic activity, but they are beginning to be recognised as ‘emerging’ sectors and industries.⁴⁹ These new technology-based sectors are likely to become large or even dominant sectors in the Blue Economy over the next decade. Renewable energy generation is feasible in many locations, and is likely to replace offshore oil and gas in many ocean economies.

Economic development strategies based on science and technology form the key worldwide. Such strategies usually begin with a focus on research and education, particularly higher education. The Blue Economy focus is on the marine research and education sector, which is widely recognised as being key to the Blue Economy. The emphasis is partly on the research and development pipeline and partly on the skilled workforce needed to develop and deploy technologies.⁵⁰

There are undoubted advantages to developing capacity for technological development, but the barriers for lower income countries are high. Technology, however, is not the most important form of innovation. Contemporary economic development theory focuses heavily on the concept of clusters as drivers of innovation. Clusters are regional agglomerations of related economic activity where institutions, relationships, and markets integrate to deliver external economies of scale that sustain both innovation and competitiveness.⁵¹

The Porter 'diamond' model is the most widely used conceptualisation of cluster structures.⁵² This model envisions clusters as the relationships among:

- *Firm Strategy, Structure and Rivalry*: encompasses the behaviour of individual firms; what they decide to emphasise in their management; the cooperative and competitive relationships among firms; and market structure.
- *Demand Conditions*: the business environment characteristics already discussed, plus macro-economic conditions such as interest rates, growth, and trade.
- *Factor Conditions*: refers to the underlying cost and availability of the factors of production (land, labour and capital).
- *Related and Supporting Institutions*: the network of organisations in education, research, the public sector, and elsewhere – which provides inputs but also affects firms through regulations, subsidies, etc. Cluster development strategy often focuses attention on these institutions, such as those involved in research and education.

The essential observation in cluster theory is that innovation and sustained competitiveness does not arise from the actions of any single firm or organisation but from the way that all the elements interact to shape conditions for current economic success and the capacity to both create and adapt to changes in technology, institutions, and the environment. Innovation is embedded in the evolving knowledge shared across institutions within a region.

The basic principles of clusters apply to all industries and sectors, and innovation in many industries is less a factor of new technology than how to better deploy existing technologies, how to develop networks with related and supporting institutions, and how to innovate competitive strategies. In a detailed analysis of the US economy, the Harvard Business School Institute for Strategy and Competitiveness examined clusters such as financial services, real estate development, amusements and recreation, mutual funds, telemarketing, and insurance.⁵³ All these service industries rely on information and communications technology, but the technology enables innovations in the services provided much more than the other way around.

This broad applicability of cluster approaches means that all the components of the Blue Economy can be assessed in cluster terms, and innovation strategies can be developed for each industry. Competitive potential can be found by discerning the current characteristics in each element of the diamond and comparing the current situation with the elements of successful clusters elsewhere. Clusters can emerge at the subnational, national, and cross-national levels. Smaller countries can gain innovative capacity through the networks they maintain with related and supporting institutions in larger countries.

The concept of an ‘innovation Blue Economy’ – a sub-set of some larger concept of the Blue Economy – is, therefore, highly misleading. All of the Blue Economy – the economy related to the ocean – must be innovative. The array of current challenges to the Blue Economy is formidable, from over-fishing and highly competitive global markets, to the standard challenges facing lower income countries and the unique challenges of finding compatibility with the marine environment, as well as the current and increasing challenge of climate change.⁵⁴

Another aspect of clusters is of particular importance to the Blue Economy. In his seminal work on clusters,⁵⁵ Michael Porter observes that environmental regulations can enhance competitiveness, rather than just raise costs and reduce competitiveness. This is obviously a key idea for the Blue Economy. Research into what became known as the ‘Porter Hypothesis’ has been extensive and generally supportive of the positive association between environmental regulation and economic performance.⁵⁶ The research indicates that environment regulation encourages innovation by businesses, but that innovation in environmental policy is a prerequisite for success, as discussed above with respect to setting limits. This interaction between environmentally sustainable action and increasing competitiveness needs to be carefully understood for each related industry, because it represents the kind of outcome embodied by the Blue Economy.

Measurement

‘What you measure is what you manage’ is a saying that is often, but probably apocryphally, attributed to the management theorist Peter Drucker. The idea that management tends to focus on the things where measurement makes change visible and quantifiable is a very old idea. Though it is also true that ‘what is valuable is not always measurable’, we do need to understand how the complex components of the Blue Economy are changing. There are three key areas for developing measurements essential to the Blue Economy:

- Physical and biological conditions of the ocean
- System-level measurements of ocean economic values
- Ocean-related economic values appropriate for evaluating investments.

Physical and biological conditions are the subject of ongoing marine research programmes in all countries, but almost all marine research is targeted at specific issues, areas, resources, and conditions. The overall conditions of the oceans, on the other hand, are the subject of the Global Ocean Observing System (GOOS), an international network of monitoring stations that use a variety of fixed and mobile

platforms as well as satellite measurements to continuously monitor characteristics such as temperature, salinity, currents, and climate/weather conditions. The Indian Ocean is a critical part of the GOOS because of several major ocean elements such as the Monsoon. The Indian Ocean is also affected by major Pacific Ocean features such as the El Nino-Southern Oscillation (ENSO).⁵⁷ The results of marine research and the data from the ocean observing systems form critical information inputs to Blue Economy decisions, but detailed discussion of these measurements lies beyond the scope of this paper.

The measurement of ocean economic values at the system (national) level is a rapidly evolving field of research and restructuring of national data systems. In the past decade, a number of countries around the world have developed some form of specialised adaptation of their national income and product accounts to identify and track the contribution of the oceans to national and regional economies.⁵⁸ These efforts track the output of the Blue Economy on an annual basis and help address questions about its size relative to other industries/sectors and the growth trends that emerge over time.

Identification of the ocean-based contribution to national and regional economies is the first step in measuring the Blue Economy. This requires separating ocean-related from non-ocean-related economic activity. A comparison of ‘ocean economy’ sectors, as defined by a dozen countries, reveals three groups of industries: (1) core industries, which are included by almost all countries in their ocean accounts; (2) industries recognised as part of the ocean economy, but which are included less often; and (3) industries named by a relatively small number of countries (Table 2.2).

Table 2.2: *Ocean Economy Industries as Defined by 12 Countries*⁵⁹

Core Ocean Industries	Marine Fishery Offshore Oil and Gas Industry Ocean Mining Industry Ship and Boat Building Marine Engineering and Construction Communication and Transportation Coastal Tourism and Recreation Marine Science Research Marine Education Marine Management/ Pub Admin/Defence
Common industries, not commonly measured	Marine Electric Power Industry Ocean-related Services Marine Insurance and Social Security Industry Marine Technology services

New, Emerging and Specialised Industries

Marine Environment Monitoring and Prediction services
 Marine Geologic Exploration Industry
 Marine Environmental Protection Industry
 Marine Social and International Organisations
 Marine Agriculture, Forestry Industry
 Ocean-related Products and Materials Manufacturing
 Ocean-related Installation Industry
 Marine Wholesale and Retail Industry
 Marine Chemical Industry
 Seawater Utilisation Industry
 Marine Information Services
 Marine Salt Industry
 Marine Biomedicine Industry
 Marine Equipment industry

The differences in Table 2.2 arise for three reasons. First, differences in data collection methods allow the marine components of some industries to be more precisely identified in some countries than in others. Second, supplier industries such as insurance are defined in the ocean economy in some countries' ocean economy figures, while in other countries these industries are reported in separate input-output derived estimates. The third reason is that industries are present in some countries but not others; desalination and ocean based renewable energies are examples. The differences in measurement approaches restrict cross-national comparisons, but the immediate needs are for national definitions and measurement. Here the variety of approaches provide different examples for countries developing their own ocean accounts.

The next steps expand this measurement aspect to address the other major goals of the Blue Economy: environmental effects and distribution implications. The methods for addressing the measurement of environmental effects are generally well established in theory, but present significant issues in data collection. The measurement of distributional consequences presents issues in both theory and data.

The absence of the measurement of environmental values in the national income accounts has long been recognised as a significant limitation on the availability of needed economic information.⁶⁰ However, there has been substantial progress in the last decade in developing both the theory and methods to incorporate environmental information in national accounting. The result of these efforts has included both new standards for environmental accounting as well as new data sets.

Measurement of national economies has been largely standardised through the United Nations System of National Accounts (SNA).⁶¹ The SNA standards apply to

collecting and reporting on gross domestic product and its related measures (e.g. gross national product, gross national income, etc.). The output and related data for the ocean economy discussed should be reported so as to be consistent with the national income accounts defined by the SNA. To these standards have been added the System of Environmental and Economic Accounts (SEEA)⁶² and the Experimental System of Ecosystem Services Accounts (ESEA).⁶³ These two accounting standards both attempt to add the concept of 'natural capital' to the national income accounts, but take different approaches reflecting on the theoretical and empirical bases for different parts of the environment.

The SEEA adds two dimensions to the national income accounts. The first is creation of natural resource stock accounts with a focus on extractive resources, which in the marine context applies to fisheries and minerals. The SEEA resource stock accounts measure both the physical size of the resource (e.g. biomass in the case of fisheries) and its value measured at market prices. The stock is measured at the beginning of the year, and then the flows are added over the course of the year so that the change in the value of the stock over the year is measured. Flows include both increases in physical size and value and reductions in physical size and value. In fisheries, positive flows include birth of additional fish (recruitment) and negative flows (catch plus natural mortality). These measurements should show, in the case of a renewable resource such as fisheries, whether annual operation of the fishery is staying within sustainable limits.

The other addition to the economic accounts made by SEEA is the measurement of environmental and resource management spending as a distinct category. Such spending includes public sector expenditures on environmental and resource management, including planning and policy development as well as implementation and enforcement. It also includes private sector spending on compliance with environmental regulations, both capital and operating. The purpose of measuring these expenditures is to measure the level of economic resources being committed to maintaining or cleaning the environment. However, expenditure on the environment is a somewhat ambiguous measure of environmental improvement. An increase in expenditure on environmental management does not signify that the status of the environment is improving as a result. Neither does it signify that the environment is degrading and thus requires additional expenditure.

The need to measure the condition of the environment, rather than simply the spending on it, has led to a shift towards measuring the value of ecosystem services, which is the purpose of the Experimental System of Ecosystem Services Accounts. Ecosystem services are classified by the Common International Classification of Ecosystem Services (CICES) into three broad categories or sections; provisioning, regulating, and culture; and then into eight divisions and 20 groups of services (Table 2.3).

Table 2.3: *CICES Classification of Ecosystem Services*⁶⁴

Section	Division	Group
Provisioning	Nutrition	Biomass Water
	Materials	Biomass, Fibre Water
	Energy	Biomass-based Energy Sources Mechanical Energy
Regulation and Maintenance	Mediation of Waste, Toxics and other Nuisances	Mediation by Biota Mediation by Ecosystems
	Mediation of Flows	Mass Flows Liquid Flows Gaseous / Air Flows
	Maintenance of Physical, Chemical, Biological Conditions	Lifecycle Maintenance, Habitat and Gene Pool Protection Pest and Disease Control Soil Formation and Composition Water Conditions Atmospheric Composition and Climate Regulation
Cultural	Physical and Intellectual Interactions with Ecosystems and Land-/Seascapes [environmental settings]	Physical and Experiential Interactions Intellectual and Representational Interactions
	Spiritual, Symbolic and Other Interactions with Ecosystems and Land-/Seascapes [environmental settings]	Spiritual and/or Emblematic Other Cultural Outputs

Source: Author's own construction

The difference between the values estimated in the SEEA and the ESESA can be illustrated using the example of fisheries. The natural capital valued in the SEEA resource accounts is that associated with the fish, while the natural capital valued in the ESESA are the aspects of the ecosystems (such as wetlands that serve as habitat or clean water) that create the conditions for the fish to propagate. But the fisheries related benefits are only part of the values associated with coastal wetlands, which can be valued as a nursery habitat for fisheries (provisioning), as protection against flooding (regulation), and as a recreational (cultural) facility. The value of the wetlands is the sum of the value of all the services provided.

Merging the data from the System of National Accounts, as adapted for ocean related activities, with the relevant data for marine resources from the SEEA and

from the ESESA makes it possible to envision a consolidated Blue Economy account. This consolidated account would include both the gross ocean product (contribution to the national economy measured on a value-added basis) and the net ocean product, the gain (or loss) in physical and natural capital for any given period, as illustrated in Table 2.4.

Table 2.4: *Net Ocean Product Accounts*

Investment Capital (System of National Accounts)						
		Opening Stock	+ Additions	- Withdrawals	- Depreciation	Net Product
Non-residential	Structures					
	Equipment					
	Intellectual Property Products					
	Inventories					
Residential						
Environmental Capital (System of Environmental and Economic Accounts)						
	Physical Account	Economic Account				
		Opening Stock	+ Additions	- Withdrawals	- Depletion	Net Product
Minerals						
Fisheries						
Ecosystem (Natural Capital) (System of Experimental Ecosystem Services Accounts)						
	Physical Model	Economic Values				
		Opening Stock	+ Additions	- Withdrawals	- Depletion	Net Product
Producing						
Regulating						
Cultural						

Source: Author's own construction

The valuation of ecosystem services thus provides a much more complete picture of the economic value of the environment, which will be essential to fully implementing the idea of the Blue Economy. But the valuation of ecosystem services presents methodological challenges, because many of those values cannot be observed from actual market transactions, as is done with other elements of national income accounting. Methodologies for estimating surrogate values when market

transactions have been developed,⁶⁵ but inconsistencies in measurement among these methodologies led to the ESESA standards recommending that only transaction (market)-based values be used in accounting systems.

But the non-market values of ecosystem services are still important for evaluating individual investment decisions. A decision to conserve a coastal wetland will need to include the recreational values associated with that wetland even if those are not determined by market transactions for access to the wetland. The principle that economic value should reflect changes in individual welfare, rather than just transactional values, has been the foundation of cost-benefit analysis, which is the appropriate economic evaluation method used when making capital investment and programme decisions in the public sector.⁶⁶

The complexity of measuring ecosystem service values has led to several international projects to improve the methodologies and build data systems from which locally appropriate estimates can be derived. These include the WAVES project sponsored by the World Bank;⁶⁷ the Natural Capital Project;⁶⁸ The Economics of Ecosystems and Biodiversity project of the European Commission;⁶⁹ and the Natural Capital Coalition, which sponsors a number to implement the Natural Capital Protocol.⁷⁰

While much progress has been made in measuring the changes in capital value of both physical and natural capital, less progress has been made in the measurement of human capital. The measurement of human capital is seen from two different perspectives. One approach focuses on the gains to individuals and organisations from increases in wages paid in return for increases in skills and knowledge.⁷¹ The other looks at those increases in wages from a systems perspective to assess whether the gains from increased economic activity are being distributed to both capital owners and employees.

This latter perspective connects increasing returns on human capital to efforts to expand the measurement of economic and social conditions beyond the national income accounting framework. Just as the environmental and economic accounts comprise efforts to overcome the deficiencies in national income accounting with respect to the environment, several efforts have been undertaken to more completely measure the concept of national well-being. Among these are the inclusive wealth measures from the World Bank⁷² and the OECD Framework for Assessing Job Quality.⁷³

The task of measuring the Blue Economy is formidable. In general, theoretical frameworks and methods for measuring the complex components and relationships of the Blue Economy are well established, but the data needed to provide the information within those frameworks is either non-existent or in sporadic data sets lacking spatial and temporal comparability. This creates a conundrum: a great deal of measurement is needed to manage efforts at creating the Blue Economy, but the task of assembling, storing, and analysing that information must be a major task on its own.

Designing a Blue Economy Action Programme

The fundamental requirement for achieving the Blue Economy's goals of balancing development of ocean resources within environmentally and socially sustainable limits is attention to five different dimensions: investment, customers, management, innovation, and measurement. But each of the nations in the Indian Ocean region starts its journey towards a Blue Economy from a different place. Table 2.5 below indicates the approximate status of Blue Economy efforts in the countries of the Indian Ocean Rim Association (IORA) at the time of writing. The table is more illustrative than definitive. It was compiled through Internet searches in English for Blue Economy related documents in each country. It is likely that more information is available in each country's official language and that countries may be more advanced in Blue Economy activities than is recorded at the time of writing, in June 2017.

The next step is for some form of assessment of the opportunities created by the Blue Economy, of which there are many examples in the region. This starts with identifying the sectors of national economies that relate to the oceans, as well as the best current information on the status of ecological resources. These assessments should point to both opportunities and challenges appropriate to each country.

The transformation of assessment into strategy and actions will comprise the implementation activities necessary for a Blue Economy and should be divided into short and long term strategies addressing the five elements of the Blue Economy. The short term may be defined as capacity building, and should take place over a three to five-year period dating from the commitment to a Blue Economy policy. During this period, the greatest attention should be paid on arresting trends which run counter to the Blue Economy objectives and developing the systems needed for managing the Blue Economy into the future.

Most ocean and coastal ecosystems and economies are in far from optimal condition. It is said that the first task in getting out of a hole is to stop digging. In the short term, major deficiencies in the Blue Economy need to be addressed. Safety and security issues are very high on the list for many countries; if a nation cannot effectively enforce its remit within the limits of its exclusive economic zone (EEZ), the Blue Economy will be crippled from the start. Issues such as IUU (illegal, unreported and unregulated) fishing, along with severe over-harvesting in fisheries and, in some countries, maritime piracy, must receive priority attention and goals must be set to significantly reduce and eliminate these activities. A second issue is addressing major pollution, particularly water quality. Cleaning up coastal and marine waters, particularly in low income countries, is a multiyear task, but clear goals and strategies must be defined as a high priority.

The next step is to create or improve management capacity in each of the following areas:

- organisations
- networks
- competitive strategy
- spatial management
- measurement.

There is great diversity in the organisational structure and culture of the governments of coastal nations, so there is no 'right' way to organise for the Blue Economy. Some nations may choose to create or enhance an 'ocean ministry', while others may create an inter-agency council or task forces, or all of the above. Whatever is determined to be the most locally appropriate structure, organisation for the Blue Economy will require leadership from senior political levels, ongoing mechanisms for interagency coordination, and a commitment that the Blue Economy is a matter of concern across government agencies and across government levels. In addition, the old saying that 'budget is policy' can also be inverted here: policy follows budget, so funding is one key to creating cross-organisational efforts.

Networks are the formal and informal relationships that cluster theory designates as 'related and supporting' institutions. Relevant networks will comprise public and private sector organisations, educational and research institutions, and non-governmental organisations. The relationships among different institutions will usually form around discrete projects, for example, a coastal management plan for a specific region or a training programme for an expanding industry. Relationships that arise from specific projects should be continued over time and evolve into networks of regular interaction that bring the cumulative experience of many individuals and organisations to bear on Blue Economy development, in order to catalyse innovations.

Competitive strategy combines an understanding of customers as described above with the management decisions that define how those customers will be served. Competitive strategy also involves understanding of market structure, both domestically and in international markets served and potentially served.

Spatial management refers to the establishment, improvement, or expansion of integrated coastal zone management, marine spatial planning, and marine protected areas. Spatial management may also include the development of specific regional-level Blue Economy plans that address specific regional strengths and needs.

The development of the means for measuring the Blue Economy begins with defining the ocean-related economy within existing economic statistical series,

particularly national income accounts, although the ocean-related components of employment and income series may also be included. Decisions are needed concerning appropriate participation in ocean observing systems; and strategies for collecting economic and environmental data are needed for the environmental and ecosystem services accounts established.

From the foundation of organisational, policy, and data development, long-term strategies comprising investment decisions in each of the capital areas can be implemented. The identification of investment opportunities in each of the categories will, of course take place during the capacity building phase, and will offer further occasion for building the relationships, data systems, and organisational resources needed. The exact steps needed in the capacity building and long term investment phases will vary significantly by country, depending on the starting point, resources, and specific Blue Economy issues that must be addressed.

The attention that so many countries are giving to the Blue Economy is not misplaced. The gains in economic output, employment and environmental quality that can result from successful implementation of Blue Economy concepts and principles are likely to be truly transformative for regions and nations, particularly in lower income countries that will have the chance to achieve higher levels of development with much lower environmental costs than countries with higher incomes but legacy environmental degradation. But the challenges and issues equal the opportunities.

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Towards Estimation of the Blue Economy

An Accounting Framework for IORA

Saroj Kumar Mohanty

Introduction

The global development paradigm has changed since the post-World War II period. Discussion is centred on sustenance of economic growth coupled with the use of resources. In the post-war period, development strategy focused on revival of the world economy. As a sequel to this, after the 1950s, 'growth oriented' strategy was emphasised to maintain full-employment equilibrium. The global economy has since experienced resource scarcity. The coming generation faces the possibility of deprivation. This prospect was raised at the Earth Summit held in Rio de Janeiro in 1992.¹ Subsequent summits highlighted the threat to growth prospects due to resource depletion and cautioned that future development strategy should aim for high growth, less utilisation of resources, and sustainable development. Despite support at the First Earth Summit for a paradigm shift in development thinking, contemporary strategy has had very little effect.

More than two decades later, the world economy had neither alleviated poverty nor promoted efficient use of resources. The Blue Economy has emerged in the twenty-first century as a development paradigm that amalgamates positive elements of both growth oriented and sustainable development approaches. This paradigm has been accepted by the vast majority of developing and developed countries.² From the literature, it is clear that the Blue Economy holds great economic potential for littoral countries. Variations in natural endowments in Blue Economy sectors make it difficult to predict their importance in a particular country.³ The possibility of promoting Blue Economy remains a mammoth task. It is important, however, to estimate the contribution of Blue Economy sectors to the overall Gross Domestic Product (GDP) of a country.

Spotty evidence indicates that the Blue Economy could be a driver of economic growth and could set a littoral economy on a high growth trajectory. It has been

observed in developed and emerging countries that Blue Economy sectors have spread over both traditional (i.e. tourism, ports, transport, etc.) and modern sectors (i.e. marine biotechnology, biopharma, bio-food additives, etc.). Global import demand is likely to grow in these sectors, raising the prospect of large employment potential – both for blue collar and white collar workers.⁴ Private sector participation in the promotion of Blue Economy is important, since state participation in these sectors is minimal. Government and the private sector should collaborate to optimise production, employment, blue trade, and capital formation. These developments would likely enhance economic welfare. One can draw lessons from the experience of both developed and developing countries, including the European Union (EU), China, Mauritius, Singapore, and Malaysia, who have benefitted from Blue Economy initiatives.

Opportunities in the Blue Economy have been enormous, and sustainable growth can be expected from the development of those key sectors that are tailor made for individual countries, such as the marine manufacturing clusters⁵ developed in China, thanks to medium-term perspective planning.⁶ Similar successes have been experienced in other countries.⁷ In most European and Scandinavian countries, development of maritime clusters (consisting of projects associated with maritime activities) is a major manufacturing activity. For evolving such strategic sectors, medium and long-term investment planning is required, and predictability of domestic policy remains an important factor. In many key sectors, ‘blue innovation’ and ‘blue tech’ may be essential, in order to provide technological thrust to the creation of marine clusters.⁸ Similarly, modern marine sectors, such as biotechnology, pharmaceuticals, food additives, and cosmetics, can be developed as an integral part of a Blue Economy business model.⁹ In order to develop such sectors, financial planning is required. In such cases, several modern blue sectors are spotted as high-risk areas for investment, and foreign investment may be encouraged to supplement domestic investment. As finance remains an important aspect of policy planning in developing countries, identification of priority sectors is important, and Blue Economy accounting is required.

Blue Economy comprises both traditional and modern sectors, and future growth is critically contingent on ‘blue tech’ initiatives.¹⁰ In the US, nearly 4 000 ‘blue tech’ firms are working in the ocean sector and many of them are SME (small and medium-sized) firms. India and other littoral countries in the Indian Ocean Rim Association (IORA) should promote ‘blue tech’ firms, in order to develop ocean sectors using ‘blue innovation’. It should be noted that ‘blue innovation’ is the cornerstone for the growth prospects of the ocean sector.¹¹ With the proliferation of ‘blue tech’ firms, the economy may be able to generate white collar ‘blue jobs’ in diversified sectors. This requires ‘blue skill’ development planning with a vision to meet future requirements of sectors associated with the Blue Economy. For taking

these initiatives forward, a ‘blue voice’ should be promoted at domestic and international levels. An international ‘blue voice’ is required to raise awareness about the Blue Economy as a dominant development strategy and also to help define and classify the strategy.¹² Global consensus on the structure of a Blue Economy would end the decade-long anomalies with definitional issues regarding ocean/marine/coastal/Blue Economy. At the domestic level, a clear framework would facilitate national and regional action plans for potential Blue Economy sectors.

This chapter is organised as follows: Section 2 presents an overview of the definitional issues relating to Blue Economy; Section 3 gives a framework for the estimation of Blue Economy; Section 4 provides an analytical framework to estimate a Blue Economy for India; Section 5 discusses the strength of the global ‘blue voice’; Section 6 evolves a global framework to resolve issues related to classification; and the final section draws a conclusion.

The ‘Blue Voice’ supporting the ‘global consensus’ on Blue Economy

At the second Earth Summit (held in Johannesburg in 2002), small island developing states (SIDS) resolved to adopt the Blue Economy as a development strategy. Littoral countries recognised the merits of Blue Economy strategy, but no consensus about the Blue Economy was forthcoming at the conference.¹³

Since 2012, the gravity of the argument concerning Blue Economy has come to the fore and several initiatives and ministerial declarations were adopted to reinforce the relevance of the Blue Economy as an alternative development strategy. Some ministerial declarations and regional initiatives are listed in Table 3.1. This analysis reflects growing consensus for Blue Economy as a considered strategy that requires further investigation.

Table 3.1: *Total number of countries supporting Blue Economy*¹⁴

Arrangements/Ministerial Declaration	Year	No. of Countries
Indian Ocean Rim Association Ministerial on Blue Economy	2015 and 2017	21
Small Island Developing States	2012	47
APEC: Xiamen Declaration	2014	21
EU: Blue Growth for Sustainable Blue Economy	2017	27
Mediterranean Ministerial on Blue Economy	2015	11
Total number of countries		115

The SIDS countries extended their support for the new alternative strategy at the Earth Summit held in Rio de Janeiro in 2012 (also known as Rio+20 or Rio 2012). This was followed by the 'Xiamen Declaration' in the Asia-Pacific Economic Cooperation (APEC) meeting in 2014, which focused on the development of Blue Economy initiatives. In 2015, the first Blue Economy Ministerial Meeting of the Indian Ocean Rim Association (IORA) was held in Mauritius, where a strong resolution to promote sectoral activities based on the Blue Economy was adopted. The Mediterranean Ministerial on Blue Economy passed a declaration supporting the adoption of new policies to promote sectors in this area in 2015. In March 2017, the European Union Blue Economy Ministerial Meeting adopted a declaration in favour of Blue Economy. Similarly, on 6 May 2017, the Second Blue Economy Ministerial Meeting of IORA adopted some strategies to promote Blue Economy through a declaration. Certain priority sectors (including fisheries, which have great potential in the region) are highlighted in regional policies promoting Blue Economy strategy.¹⁵ Countries such as Mauritius, the Seychelles, Malaysia, and Grenada have adopted country-wide development models based on Blue Economy. Clear consensus is emerging in favour of a Blue Economy strategy. From the major declarations listed in Table 3.1, we identify 115 countries that support Blue Economy as a growth driver.

This shows that there is growing convergence between developed and developing countries in recognising the relevance of Blue Economy as an alternative development strategy. Of these countries, 28 belong to the industrialised world and 87 are developing (including 18 emerging). Spatial distribution of these countries indicates that 31 countries are from Asia, 16 from Africa, 27 from Europe, 23 from Latin America and the Caribbean, and 16 are from Oceania. Several regional groupings are strongly represented by these countries.

Following the second Earth Summit in 2002, recognition of the Blue Economy as an alternative development strategy has increased. By 2007, a substantial number of countries had joined the 'blue voice' in supporting the strategy. These countries, in terms of their number and economic accomplishment, are becoming significant in the world economy in advancing the causes of Blue Economy. How important are these voices? These countries have a strong economic foothold on global output, resources, and trade. As discussed earlier, these 115 countries shared 81 per cent of the global GDP and 71.4 per cent of the total population of the world. The group's considerable demand for goods and services is shown in Table 3.2. To bring about modernisation and innovation, the Blue Economy requires high and quality investment in each of these countries. Incidentally, high resource generation capacity has been shown by these countries to push several blue initiatives in recent years. In this regard, these countries have significant resource base, which is reflected in terms of high capital formation and savings rate.

Table 3.2: *Profile of Group of Countries that officially support the rationale of Blue Economy[†]*

Macro-economic Variables	Macro Variables (in \$ Tn)		Share in the World (%)		CAGR (%)	
	2007	2014	2008	2014	2008-11	2011-14
GDP (current)	47.5	63.7	81.9	81.0	4.7	2.3
Population*	6.7	7.3	71.4	70.3	0.9	0.9
Gross capital formation (constant 2010)	13.3	15.6	84.9	84.7	1.8	3.3
Gross capital formation (current)	12.2	16.8	84.4	84.3	4.6	3.2
Gross domestic savings (current)	12.4	17.3	83.1	83.9	5.0	3.9
Foreign direct investment, net inflows	2.5	1.3	74.1	76.1	0.8	-10.0
Foreign direct investment, net outflows	2.6	1.5	78.0	93.2	-3.2	-7.5
Goods exports (BoP, current)	10.8	14.6	77.0	77.9	4.2	1.8
Goods imports (BoP, current)	10.8	14.5	79.8	79.4	4.1	1.0
Exports of goods and services (constant 2010)	13.1	15.9	71.1	72.3	2.3	3.4
Exports of goods and services (current)	13.9	19.2	79.4	80.2	4.4	2.5
Imports of goods and services (constant 2010)	13.3	15.6	73.6	73.1	1.7	2.6
Imports of goods and services (current)	13.7	18.7	81.0	80.5	4.0	1.8

Source: Author's calculation based on World Development Indicators, World Bank, 2017

Note: *Population in billion, † Refer to Table 3.1

These 115 countries support the Blue Economy and have a significant stake in global economic activity, as shown in Table 3.2. These countries have also witnessed a significant flow of inward and outward foreign direct investment (FDI) with the rest of the world, showing the ability of their economies to finance high yielding projects. In this context, 'blue investment' can be mobilised effortlessly to finance efficient marine projects, which has the potential to generate high yield. On the trade front, this group has large commerce with the world and has grown significantly in terms of volume of trade during the period of recession. In recent years, its real imports of goods and services expanded more rapidly than its exports,

showing the resilience of the group in absorbing global shocks. It is important to note that this group is producing, investing, and trading relatively more than its share of the global population. Since the dominant segment of the world economy is supporting the Blue Economy as an alternative development paradigm, one may conclude that there is growing global consensus in support of the Blue Economy and that the 'blue voice' is likely to shape global governance in future.

Definition and conceptual framework

Several terminologies have been used to conceptualise activities in an economy having direct and indirect influence on the ocean. These terminologies include Marine Economy, Ocean Economy, and Blue Economy. Occasionally vernacular languages are also used to refer to ocean economy. These terminologies are often used interchangeably in the literature. A global pattern is emerging in the use of these terminologies.¹⁶ While the US uses 'Ocean Economy', Mauritius employs 'Blue Economy', and the UK uses 'Marine Economy'. Another study¹⁷ observes that the Coastal Economy is a part of the Overall Economy and the Ocean Economy is a sub-set of the Coastal Economy.

A considerable level of homogeneity exists in the use of terminologies such as Ocean Economy, Marine Economy, and Blue Economy. Some degree of heterogeneity exists, however, in terms of coverage of sectors.¹⁸ Most of these terminologies are used to refer to oceans in different countries. The term 'Marine Economy' is used in Australia, the EU, France, the UK, and New Zealand. The 'Ocean Economy' is used in Ireland and the US. 'Blue Economy' is used in India, Mauritius and the Seychelles. China, Japan, and South Korea use local languages and refer to 'Ocean Economy' in English. However, coverage of sectors differs from one country to another. While some countries have more sectors, others have fewer sectors, and that becomes the point of divergence in coining the terminology. Blue Economy is a wider concept than Marine Economy, whereas Ocean Economy is a sub-set of Coastal Economy.

Though several countries use similar terminologies for ocean/Blue Economy, their coverage of sectors in the accounting framework is not identical, which complicates a comparison of estimates between countries. This may be due to the fact that some sectors seem to be contentious in nature. In the accounting framework, marine activities are mostly considered, but what about land-based activities related to oceans? For several sectors such as travel, tourism, and insurance, segmentation of activities as 'land-based' or 'marine-based' would be a difficult proposition. Similarly, in several sectors, demarcation of activities between government and private sectors, such as port and marine insurance, is a complex

problem. In such cases, differentiation of activities for accounting purposes is difficult. It is also argued that defence activities should not be part of Blue Economy activities. If this is the case, activities of the navy or coast guard may not be part of the Blue Economy accounting framework, but are part of the national income accounting framework. Sometimes it is argued that activities across the coastlines should form part of 'coastal economy' estimations, but not those ocean related activities that are performed in the hinterland. Several such examples are discussed in the literature, which is contributing to consensus on a universally acceptable definition of Blue Economy. A concise definition was lacking when there was no consensus on Blue Economy as an alternative paradigm of development,¹⁹ but the situation has changed in recent years.

A recent study²⁰ has defined three concepts based on the global debate. According to the study, the Ocean Economy is dependent on the ocean for inputs to run certain production processes in coastal and non-coastal regions, and these activities are identified by both industry and geographical location. Coastal Economy is much wider in its application than Ocean Economy: it includes the sum of output, employment, and wages on or near the coast. The study has defined Blue Economy as covering all ocean related activities – including direct and indirect support activities required for these economic sectors to function.

Framework for estimation

The economic and strategic relevance of the ocean was known for centuries, but modern use of the ocean's resources in economic development was worked out in the early 1970s. Developed countries realised the economic significance of the ocean much earlier than developing countries. The process, in this regard, began with the US and was then followed by selected European countries. To absorb the full impact of the ocean in terms of its contribution to the economy, it was felt in the US that measurement of the potential advantages was critical.²¹ In order to account for the ocean related economic activities, the US used the Standard Industrial Classification (SIC) system at the beginning, but soon replaced it with the North American Industry Classification System (NAICS) for economic activity classification. The US took the lead in estimating the contribution of the ocean to its economy in 1972.²² A series of related estimates followed.²³

The framework for the measurement of the Blue Economy was further refined by the National Ocean Economics Program (NOEP) to develop a better strategy for the economy.²⁴ The EU also followed the US strategy in evolving a separate economic activity classification, i.e. NACE (*nomenclature statistique des activités économiques dans la Communauté Européenne*/statistical nomenclature of economic activities in the

European Community), for Blue Economy accounting. It is more comprehensive than the US counterpart in terms of coverage of sectors. The NACE has covered several other issues, including carbon capture and storage, coastal protection, and desalination. Several studies started rebuilding the framework of classification by using alternative International Standard Industrial Classification (ISIC). Apart from the US and the EU, several other countries have estimated the contribution of Blue Economy to their GDP.²⁵ In the absence of a commonly acceptable classification, a cross-country comparison of estimates is not possible and a global classification that is based on ISIC classification is suggested.²⁶

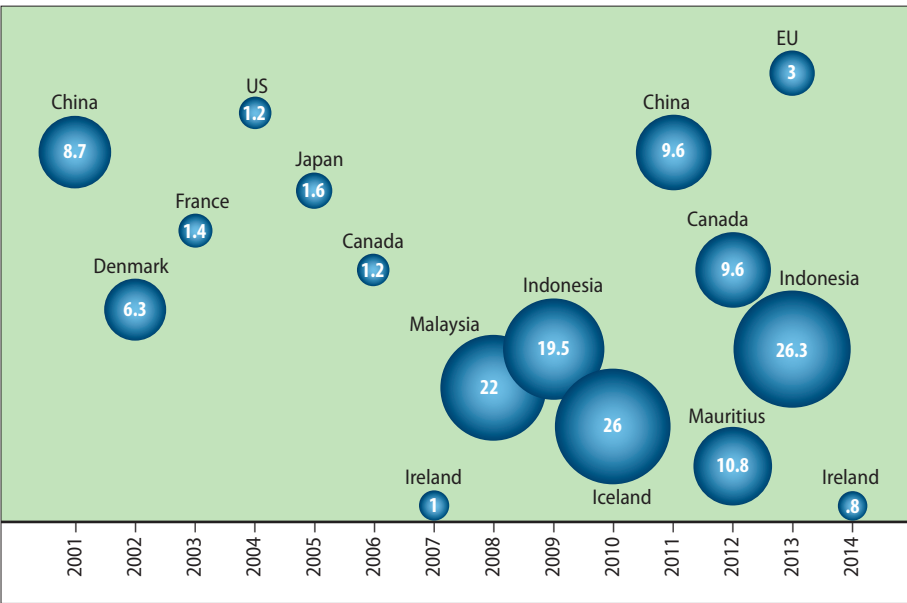
‘Stylised facts’ for Blue Economy

It is evident from the literature that littoral countries are endowed differently as far as their marine resources are concerned. These resources are strategic for a country on two counts. Firstly, many countries have marine territory that is more than double their land area. This gives them access to large marine resources. Secondly, since most of the marine resources are renewable in nature, there is little possibility of resource depletion, unless they are not preserved. Despite good access to marine resources, these countries differ significantly among themselves in terms of the contribution of their Blue Economy to GDP.

Due to the lack of consistency with definitions, methodology, and coverage of sectors in the Blue Economy, estimates for different countries are not comparable at the sectoral or aggregate level. However, such cross-country comparison is indicative in nature. It is apparent from the literature that country studies are available in select cases. Country estimates at the aggregate and sectoral level vary significantly across countries, and therefore the risk of guesstimate for a country about contribution of its Blue Economy to GDP is very high.

There cannot be a guesstimate for a littoral economy based on its size, per capita income, length of its coastline, and coastline to land ratio. Large littoral countries like China, USA, Canada, and Australia exist contiguously or in isolation, but they differ significantly in terms of their economic contribution to GDP, as shown in Figure 3.1. In the case of small littoral countries like Mauritius, Iceland, and Denmark, the share of their Blue Economy to GDP is high, despite a considerable level of difference in their per capita income. Countries present different experiences in terms of their sectoral contribution to Blue Economy GDP. The agricultural sector in Brunei shares 36 per cent of its Blue Economy GDP. Similarly, hydrocarbon accounts for one third of Blue Economy GDP in the European Union. In the Chinese Blue Economy, the share of marine manufacturing was 34 per cent in 2014. In 2015, marine services contributed 83 per cent of the Blue Economy in the US.

Figure 3.1: *Contribution of Blue Economy – Country Experiences*²⁷



Note: The size of the bubble represents the percentage contribution of Blue Economy to a country's GDP

Despite dissimilarity in economic size, the relative size of the Blue Economy in terms of overall GDP is similar in countries like China, Mauritius, and Singapore. Countries like South Africa, Thailand, Singapore, and Malaysia are similar in terms of GDP size, but they vary significantly in terms of Blue Economy contribution to overall GDP. In terms of per capita income, the Philippines, Vietnam and Indonesia are at a similar level, but not in terms of their Blue Economy contribution. Countries like Vietnam, Thailand, France, and Sweden have a similar coastline length, but contribution of the Blue Economy to GDP differs significantly. The case is similar when we consider ratios of land to coastline for countries like the United Arab Emirates, Thailand, France, Sweden and China.

It is interesting to note that countries with similar regions may not have a similar Blue Economy contribution when we compare estimates of countries within ASEAN and the European Union. In this section, we have tried to establish certain stylist facts based on several related indicators associated with the Blue Economy. From the results, it is apparent that there could not be any stylised facts on the contribution of Blue Economy to GDP. It is, therefore, necessary to estimate the contribution of the Blue Economy of a country without making a guesstimate based on other countries.

Blue Economy estimation framework for India

The Blue Economy as an alternative development strategy is a recent phenomenon in India. This is picking up very fast, with intensive discussion on SDG-14.²⁸ Several initiatives are being undertaken on the Blue Economy, which is multi-dimensional in nature. In the new political regime, the Prime Minister has undertaken several initiatives to re-emphasise the idea of the Blue Economy in maintaining sustainability and placing the economy on a high growth trajectory. Such initiatives have both domestic and international dimensions. Recently, India extended support in the area of Blue Economy to four island nations in the Indian Ocean region: Mauritius, the Seychelles, Sri Lanka, and the Maldives. Similarly, on the domestic front, several projects have been initiated, such as 'Sagarmala' and 'Mausam'. The Ministry of Earth Sciences has launched a new project, 'deep ocean mission', at the cost of US\$1.6 billion. The project will undertake research in deep sea mining and desalination of sea water.

The Research and Information System for Developing Countries (RIS), along with the National Institution for Transforming India (NITI Aayog) and Ministry of Statistics and Programme Implementation (MOSPI), has embarked on a new initiative to develop a framework for Blue Economy accounting. Based on international practices, the Blue Economy accounting framework in India has started with nine sectors, covering 33 industries from goods and services as presented in Table 3.3. For developing the accounting framework, International Standard Industrial Classification (ISIC) is adopted where value added data is to be collected at five-digit level, using Indian National lines based on National Industrial Classification 2008 (NIC). For the estimation of Blue Economy contribution to GDP, 159 sub-industries are used under the coverage of 33 industries and 9 sectors.

Some of the sub-industries are fully identified with Blue Economy activities, whereas some are partially represented, as shown in Table 3.3. Spread of wholly and partially covered sub-industries is not only identified at sectoral level but is also observed at the level of industry. Number of lines falling under partially covered sub-industry is almost double the lines covered fully. Sub-industries representing Blue Economy constitute about eight per cent of total number of lines falling under NIC 2008. Efforts are being made to have this classification more comprehensive to accommodate newer activities in specific industries.

Towards a global framework for estimating the Blue Economy

The first order of business is to develop a transparent, credible, and predictable accounting framework for estimating the Blue Economy. As discussed earlier,

Table 3.3: *Composition of Identified Blue Economy Industries in India*

Sl.	Sector	Industry	Lines Covered		Total
			Fully	Partially	
1	Living Resources	Aquaculture	9	0	9
		Fishing	6	0	6
		Manufacturing from Aquatic Products	1	0	1
		Seafood Markets	0	3	3
		Seafood Processing	9	2	11
2	Non-Living Resources	Extraction of Gravel and Sand	1	3	4
		Extraction of Salt	2	0	2
		Manufacturingto Electricity	0	1	1
		Marine Seawater Utilisation	0	3	3
		Mining of Ores	0	10	10
		Oil & Gas Exploration and Production	4	6	10
		Renewable Energy	1	4	5
		Waste and decontamination	0	1	1
		Water Collection	0	2	2
3	Ship and Boat Building	Boat Building	1	0	1
		Manufacturing to Shipbuilding	1	4	5
		Other Manufacturing and Services	0	1	1
		Repair and Maintenance	0	1	1
		Ship Building	4	0	4
4	Tourism and Recreation	Accommodation	0	8	8
		Other Tourism and Recreation Services	2	24	26
5	Transportation	Marine Freight Transportation	1	1	2
		Marine Passenger Transportation	9	0	9
		Other Support Activities to Transportation	0	6	6
		Other Support Services to Transportation	0	3	3
		Service Activities to Transportation	2	1	3
6	Education and R&D	Education	0	4	4
		R&D	0	1	1
7	Construction	Marine	1	1	2
		Marine Related	0	7	7
8	Public Administration	Provision of Services	0	2	2
9	Others	Office Support Activities	0	4	4
		Others	0	2	2
Total		All National Lines Under Blue Economy	54	105	159

Note: Based on ISIC Revision 4, National Lines

industrialised economies realised that estimation of the Blue Economy is the precursor to any valiant initiative in promoting the sector; therefore, the US and the EU evolved several regional classifications to capture all economic activities happening in the Blue Economy, such as North American Industry Classification System (NAICS) and Standard Industrial Classification (SIC). As a second-tier initiative, several other countries have tried adopting global classifications such as ISIC to undertake such an experiment in their economies. Such attempts in the past were regionalised and lacking in comprehensiveness owing to lack of proper definitions of the Blue Economy and inadequacies of the activity classifications. But such attempts by the early birds have enabled them to protect, conserve and use sustainably their ocean resources. The limited approach to the estimation of Blue Economy has been restricted to a small number of countries, but the quest to know about the Blue Economy has multiplied over time.

In recent years, large numbers of countries have shown their interest in estimates of their Blue Economy and there should be global consensus in evolving a single unified classification for the Blue Economy. Similar situations arose in the past when the global preference was invoked to understand global trade of Global Value Chain (GVC) products. To account for a complete set of global activities in GVC trade, a separate nomenclature was evolved under Standard International Trade Classification revision 2 (SITC) which accommodates the basic requirements of the sector. In this case, similar initiatives may be undertaken globally to resolve the outstanding issues concerning Blue Economy estimation. At present, a comparison of the cross-country estimates of Blue Economy is not possible scientifically, because of the use of different methodologies, classifications of economic activities, and coverage of sectors by different countries/agencies. The shortcomings in the estimation procedure may impede predictability of Blue Economy statistics in a country over a period of time and across countries. In terms of methodology, while some countries applied satellite account, others use input output framework to estimate the contribution of the sector to GDP.²⁹ There is significant difference among countries in choosing a comprehensive set of sectors to be included when estimating volume of activities in the sector. The variations in choosing Blue Economy sectors have been diverse among developed and developing countries, even among those who have been in operation over a long period of time.

As more and more countries are conscious about the relevance of Blue Economy in their own economic development, the time has matured to take a global view on evolving consensus around a framework that should consider sectoral composition, classification of activities, and inclusion of new issues. In the new framework, shortcomings of the existing economic activity classifications are not only to be corrected but also address new issues in a more comprehensive manner. It is observed that NAICS and NACE are not only incompatible to each

other in terms of coverage of sectors³⁰ but also do not have industry coverage to accommodate new elements such as ‘blue technology’ and innovations³¹ in the classification.

The proposed framework should be in the direction of new nomenclature of ISIC having more flexibility to accommodate new sectors, including new technologies and innovations. In this new round of activity classification, a complete set of Blue Economy sectors should be represented adequately on the basis of generating global consensus. The new framework of economic activities should also accommodate not only production of activities but also locations of such economic activities. For Blue Economy accounting, spatial distribution of activities needs to be focused, and each country should be encouraged to adopt a framework of Blue Economy, irrespective of whether the country is a littoral one or not. Most of the countries have rich experiences in handling ISIC economic classification. Therefore, the new round of ISIC Revision 5 should adequately represent Blue Economy activities, apart from other considerations.

Conclusion

Convergence of opinion is growing regarding the relevance of Blue Economy as an alternative development paradigm that fosters global growth prospects with sustainable management of persistently depleting natural ocean resources. The global ‘blue voice’ – which has gained strength in recent years, following the rapprochement between developed and developing countries – is to recognise Blue Economy as a credible development paradigm. Through various landmark declarations at the Ministerial level, more than 100 countries have already endorsed the relevance of Blue Economy since 2007. According to the present estimate, the emergent ‘blue voice’ is becoming robust globally, sharing 81 per cent of global GDP and more than 71 per cent of global population, and it can play an important role in shaping the future of the Blue Economy under global governance.

Blue Economy takes into account all ocean related activities along with the cost of marine environmental damages while estimating economic valuation of the activities in order to exploit resources for human consumption. The Blue Economy strategy emphasises high economic growth, but is fully conscious of conservation and rational utilisation of resources through science-based solutions to resource use. Under the broad contours of the new paradigm, ‘blue innovation’ and ‘blue tech’ have been the main instruments used to advance ‘blue growth’. Therefore, the formation of ‘marine clusters’ has been an important initiative of Blue Economy. In the coming decades, Blue Economy will emerge as the driver of economic growth for several littoral countries.

Though Blue Economy is picking up as an alternative development strategy, a few countries know about their Blue Economies fully but not others. There is growing awareness among developing countries about the use of 'blue resources' for economic development, but so far there is no commonly accepted definition of Blue Economy. There has been a lack of consensus about the sectoral classification of Blue Economy, which may be due to the engagement of a small number of countries in the estimation process in the past. Now several countries have shown interest in knowing about their Blue Economies, particularly littoral countries endowed with varieties of marine resources. A country should know its Blue Economy in order to make investment plans and prioritise its blue sectors. (For example, India's investment plan in the Sagarmala project costing \$64 billion and 'Deep Sea Mission' project costing \$1.6 billion. Similarly, the 'Indonesian Maritime Hotspot' project is a large project that requires perspective planning.) Contrary to general expectations, there are no 'stylised facts' about Blue Economy globally and there could not be any guesstimate in this regard. Blue Economy measurement is necessary for blue investment, blue innovation, blue technology and blue voice, and all of them are necessary for various purposes – including development of comprehensive policy planning.

India has raised its 'blue voice', which is reflected in its domestic and foreign policy. At the political forum, the Prime Minister of India has taken the lead in shaping the Blue Economy policy and has extended support to countries like Mauritius, the Seychelles, the Maldives, Sri Lanka, and Fiji in this endeavour. In the Ministry of External Affairs, a separate division on IOR is created to spearhead policies relating to Blue Economy along with the Ministry of Earth Sciences. The Ministry of External Affairs has initiated Blue Economy Dialogue, the 1.5 track initiative, which is meant for exchanging communication between Members of IORA countries. Along with NITI Ayog and MOSPI, RIS has developed a framework to measure the contribution of Blue Economy to GDP in India. For purposes of estimating the activities of the Indian Blue Economy, 9 sectors, 33 industries and 159 sub-industries were identified. Further, RIS has launched the Blue Economy Forum (RIS-BEF) to generate open discussion on sector-related debate across the IORA region. In addition, FICCI has developed a business model for the Blue Economy.

This is some of the evidence that specific countries are taking initiatives to measure their contribution to Blue Economy. In view of the growing interest among the majority of countries in the world economy, there should be a transparent, credible and predictable accounting framework for the estimation of the Blue Economy. The time has come to evolve global consensus on a unified classification that can improve predictability of Blue Economy sectoral performances. In the new round of ISIC Revision 5, detailed sectoral classification should be undertaken in order to resolve all anomalies relating to the Blue Economy.

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CHAPTER 4

Achieving Sustainability in the Context of the Blue Economy

Emmanuel Owusu-Sekyere

Sustainability, a dynamic concept

The idea of sustainability first emerged in a report titled, 'Limits to Growth', written by the Club of Rome in 1972.¹ This report identified five basic factors whose interaction and exponential growth could adversely affect the sustenance of the planet. The five factors cited in the study are population growth, agriculture, renewable resource depletion, industrial output and pollution. The study's main finding was that there needs to be a careful balance between population and production to ensure that the nature of economic production and population growth does not jeopardise the global systems of nature.² The Club of Rome report was therefore the first to raise the need for economic development activities to take into consideration their impact on nature. In line with the report findings, the 1974 Cocoyoc Declaration in Mexico conceptualised sustainability as 'the relationship between the "inner limits" of human needs and the "outer limits" of Earth's resources'.³ These initial concepts of sustainability highlighted two key dimensions - anthropocentric (human centred) and ecocentric (ecology centred) - which emphasised the need to consider the impact of human development activity on the earth's ecological systems.

The concept of sustainability gained further prominence in international development through a report titled, *Our Common Future*, published by the World Commission on Environment and Development (WCED) in 1987.⁴ In this report, sustainable development is defined as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'.⁵ This perspective on sustainable development has been criticised for its sole focus on humans as opposed to other life forms and for its close association of development with sustainability. Despite these criticisms, the report has served as

basis for development of a wide range of alternative dimensions to sustainability and its relationship with development and non-human life, the most recent being the Sustainable Development Goals (SDGs).

Hence, in the evolution of sustainability theory (a dynamic concept), three key dimensions emerge: an anthropocentric dimension, an ecocentric dimension, and the dimension of the future. These are interrelated. The ecocentric dimension posits that human development activities should take into account the health of the earth's ecology and not human interests alone. In contrast, the anthropocentric dimension holds the view that human existence depends on rich biodiversity and should therefore be given priority.⁶ In reality, these two perspectives are not mutually exclusive. The devastating consequence of natural disasters on humans or the extinction of some non-human species triggered by climate change provide a clear indication of nature's feedback in response to environmentally irresponsible human behaviour. In that respect, a more practical middle ground postulates that the close interaction of humans and ecology creates a moral imperative for humans to act responsibly in the interest of our own survival.⁷ The 'futuristic' angle of survival brings to the fore the need to sustain our current existence as humans, as well as the existence of non-human life forms on which humans and their future generations depend. That the survival of future generations should be considered in addressing today's development challenges raises additional concerns. What will the priorities of future generations be? With the current rapid innovations in science and technology, what world will future generations live in? And what will be the realities of this world? What time-span are we referring to as future? These questions further complicate the debate in terms of what is to be sustained, how it should be sustained, over what time-frame and for whom.

This responsibility, which lies primarily with humans, as opposed to non-human life forms, is multi-faceted and inclusive, and it cuts across all aspects of human existence. In this respect, several sustainability models have emerged, including economic, ecological, political and social models.

The economic perspective views capital (financial, physical, human and natural capital) as the main resource that needs to be sustained if provision is to be made for posterity. In this regard, sustainability is viewed as an investment problem in which returns on financial, physical, human and natural resources should be used to create greater shared value – such as social protection schemes for the poor, environmental protection measures, or some other opportunity of greater value.⁸ This further requires that economies operate within the limits imposed by nature and the environment. Such limits should, however, be clearly articulated, measured, monitored, evaluated and updated over time to be relevant to the changing realities of our world. The ecological models focus directly on natural resources and all life forms – both human and non-human – as being key to sustainability. Viewed

from an anthropocentric perspective, that which needs to be sustained includes essential natural resources, ecological systems, and the regenerative processes on which humans rely.⁹ From an ecocentric perspective, ecological systems and species should be preserved for their inherent value as generators of non-human life forms.¹⁰ Political models seek to sustain social systems and environmental management measures that ensure human dignity.¹¹ However, the political model represents the over-arching responsibility of governments to ensure that agreed sustainability standards are achieved for the other perspectives: economic, environmental and social.

Sustainability and the Blue Economy

The concept of a Blue Economy began to gain prominence in global development policy discourse at the Rio+20 United Nations Conference on Sustainable Development in June 2012, although it had been known for a couple of decades. The conference focused on two themes: improving the institutional framework for sustainable development and advancing the green economy.¹² At this conference, poverty eradication was reaffirmed as the greatest global challenge and an unavoidable prerequisite for sustainable development. Member states therefore pledged to address poverty eradication and hunger with an increased sense of urgency.¹³ The green economy was identified as one of the key tools for eradicating poverty and achieving sustainable development. The vision was to achieve the following through the green economy: ‘...sustained economic growth, enhanced social inclusion, improved human welfare and opportunities for employment and decent work for all, while maintaining the healthy functioning of the Earth’s ecosystems’.¹⁴

Coastal and island nations expressed concern, however, about the focus of the green economy and its applicability to their development needs. In the view of coastal and island states, the Blue Economy offered a more practical approach to sustainable development that was more suited to their circumstances, constraints and challenges. This created the need to give more attention to ‘blue’ aspects of the green economy, now commonly referred to as the Blue Economy in development parlance. The Blue Economy has since generated intense international momentum and opened up a large and new dimension to the environmental repercussions of global development. Consequently, institutional effort has increased and various international initiatives have emerged in relation to the Blue Economy, one of which is the Indian Ocean Rim Association (IORA). Since 2012, a new level of prominence has been given to oceans and seas in development policy and plans.

A number of challenges emerge in pursuing the Blue Economy as a channel for sustainable development. There is yet to be a universally agreed definition of

the Blue Economy in global development. However, it has been accepted to mean 'greening' of the ocean economy.¹⁵ Other terminologies, such as sustainable ocean economy, are open to widely differing interpretations. In a broader sense, ensuring a Blue Economy refers to exploring and optimising the potential of the oceans and seas for inclusive growth and development – in a way that preserves the health of the oceans. Hence the understanding that economic activity, both onshore and offshore, must be environmentally responsible and sustainable. Central to the Blue Economy concept is the need to ensure socio-economic development that avoids environmental degradation.

In this regard, many countries are beginning to design blue growth strategies. For instance, The European Commission (EC) Blue Growth Strategy is designed to move EU countries out of the current economic slump, create jobs, and enhance the EU's competitive advantage, while protecting the health of Europe's oceans.¹⁶ China also focuses on enhancing the role of the marine industry in economic growth through sustainable development and conservation.¹⁷ The challenge, though, is that standards, targets and measurement indicators to be used to assess the health of oceans around the world still constitute a work in progress.¹⁸ Whether or not the health of oceans is ensured by nations and regions is subject to significant subjectivity.

Sustainability in the ocean economy raises environmental, social and economic concerns that have to be addressed within the context of agreed environmental standards, externalities affecting neighbouring communities, and the triple policy challenge facing most developing countries: poverty, inequality and unemployment.

The rest of this chapter is structured as follows: Section 2 highlights the nature of the ocean economy and its linkages to sustainable development; Section 3 discusses challenges posed by the ocean economy to the realisation of UN Sustainable Development Goal 14 (Life Below Water); Section 4 reviews institutional barriers to the achievement of the Blue Economy; Section 5 explores Blue Economy initiatives in selected IORA member states; Section 6 proposes possibilities for measuring sustainability in the Blue Economy using a triple bottom line approach; Section 7 concludes and attempts to provide some policy recommendations.

The ocean's economy and its implications for sustainability

The ocean economy and its potential for inclusive growth and sustainable development is immense and of utmost importance – and not only to countries whose resource endowments are marine based. The interaction of the oceans and seas with the earth's biosphere and its implications for climate change impacts on both

coastal and non-coastal nations in terms of natural disasters and their attendant humanitarian crises. Box 4.1 below details a few aspects of the ocean economy and their linkages with Sustainable Development Goals (SDGs).

Ocean-based economic activities are diverse in nature and cut across several industries, both onshore and offshore. The resources of the ocean economy consist of both living and non-life resources, which are estimated at millions of different species. Diverse industries and drivers of growth are linked to these resources, which relate to different SDGs. Table 4.1 below details these links between ocean-based industries, drivers of growth, and how they relate to the SDGs. Typical examples of living resources of the ocean economy are fisheries and marine biotechnology. The fisheries industry, for instance, is evolving into diverse forms and has a direct impact on job creation and food security, which could help to meet the SDGs on eradicating poverty and hunger and ensuring good jobs and economic growth (SDGs 1, 2, 8 and 14). One of the industries to emerge out of marine biotechnology is pharmaceuticals, which leads to research and development in healthcare and industry.

Box 4.1: *Why the oceans matter*¹⁹

- The oceans occupy 75 per cent of the earth's surface area and serve as the main source of its water.
- The marine industry and coastal resources together provide the livelihood of over three billion people and represent 5 per cent of global GDP.
- Oceans mitigate the full effect of global warming by absorbing 30 per cent of global carbon emissions.
- Oceans serve as the primary source of protein for more than 3 billion people.

This has an impact on ensuring healthy lives for all – SDG 3. Non-living resources from the ocean include minerals, energy and fresh water. These generate established industries such as seabed mining, oil, and gas.

These relate to SDGs 8, 7 and 6. The oceans are also a source of tourism, recreation, and physical infrastructure developments. Drivers of growth emanating from these are an increase in seaborne trade, improved international regulations, and growth in global tourism. These have a direct relationship with SDGs 1, 3, 8, 9, 10 and 11.

Table 4.1: *Components of the Ocean Economy and the Implications for Sustainability*²⁰

Activity	Ocean Service	Established Industries	Emerging Industries	New Industries	Drivers of Future Growth	SDG Goal
Investment of living resources	Sea food	Fisheries	Sustainable fisheries Aquaculture	Multi-species aquaculture	Food security Demand for protein	SDG 1,2,3
	Marine bio-technology		Pharmaceuticals, chemicals		R&D in healthcare and industry	SDG 3
Extraction of non-living resources, generation of new resources	Minerals	Seabed mining	Deep seabed mining		Demand for minerals	SDG 8
	Energy	Oil and gas	Renewables		Demand for alternative energy resources	SDG 7
	Fresh water		Desalination		Freshwater shortages	SDG 6
Commerce and trade in and around the ocean	Transport and trade	Shipping			Growth in sea-borne trade	SDG 8, 9
		Port infrastructure and services			International regulations	SDG 9, 10
	Tourism and recreation	Tourism			Growth of global tourism	SDG 1, 8, 11
		Coastal developments			Coastal urbanisation	SDG 3, 9, 11
			Eco-tourism		Domestic regulations	SDG 3, 9, 11
Response to ocean health challenges	Ocean monitoring and surveillance		Technology and R&D			SDG 6, 13
	Carbon sequestration		Blue carbon (i.e. coastal vegetated habitats)			SDG 11, 13
	Coastal protection		Habitat protection & restoration			SDG 15
	Waste disposal					
				Assimilation of nutrients, solid waste		SDG 3, 6

Figure 4.1: *United Nations Sustainable Development Goals*²¹



Challenges posed by the ocean economy to the realisation of SDG 14

Goal 14 of the SDGs is to ‘conserve and sustainably use the oceans, seas and marine resources for sustainable development’. Although the ocean generates several benefits and economic returns, as detailed in Figure 4.1, there are adverse side effects to the health of the oceans. Fishing, one of the major industries in the ocean economy, promotes food security, reduces hunger and maintains healthy lives. One in seven people globally obtain their protein from fish and seafood.²² Approximately 50 per cent of animal protein in the diet of 400 million individuals in the world’s poorest countries is obtained from fish.²³ The aquaculture industry employs 11 million people in developing countries, half of which are women.²⁴ Inherent in the fishing industry value chain are the fish and seafood processing enterprises, restaurants, grocery shops, and a multitude of other small and medium-scale enterprises that create millions of both full-time and part-time jobs globally.

Despite these positive effects of fishing, there are threats to the health of the oceans and its sustainability over time. Fish species are rapidly depleting due to the availability of subsidies for fishing, adversely affecting efforts to save and restore global fisheries and related jobs. This causes fishing to generate US\$ 50 billion less per year than it could. Apart from over-fishing, there are other ecosystem effects such as escaping fish, pollution and its attendant health hazards, chemical and drug use, herbicides, fungicides, and habitat destruction.²⁵ Offshore oil and gas extraction and production also occasionally result in massive oil spills and potential destruction of the ocean during the construction of infrastructure and the release

of gas at sea during storage and shipping.²⁶ The oceans carry 90 per cent of internationally traded goods through shipping, port infrastructure and services. This volume of trade amounted to more than US\$4 trillion annually in 2013.²⁷ However, shipping also accounts for carbon dioxide (CO₂) emissions, acoustic pollution and oil spills. CO₂ emissions from shipping have been estimated to form 3 per cent of humanity's global emissions and are expected to rise as sea trade increases.²⁸ Shipbreaking at the end of the life cycle of ships requires the recovery and recycling of iron, copper and other potentially dangerous materials.

Shipbreaking has negative environmental effects, such as polluting beaches and coastal waters, which impacts negatively on the seafood supply of local communities. Coastal tourism accounts for five per cent of global GDP and six to seven per cent of global employment. However, it has damaging environmental and social effects on local communities if it is not properly planned and managed. Beside the negative social externalities of tourism on local coastal communities, it also generates environmental pollution in most coastal towns. Submarine cables used for 95 per cent of global telecommunications – which connect 2.7 billion²⁹ users and supports global business, finance and entertainment – have the potential to damage the ocean floor by interacting with its benthic zone.

There is a need to ensure that the health of the oceans and seas is preserved and sustained. Ensuring sustainability standards and requirements in ocean services, established industries, emerging industries, and new industries related to the ocean economy will directly ensure the greening of the ocean economy.

Institutional barriers to sustainability in the Blue Economy

Several institutional issues inhibit a uniform interpretation and consistent implementation of the Blue Economy globally. First is the extent of pluralism in the definition of a Blue Economy. The World Water Forum Baltic Ecoregion Programme uses a set of Principles for Sustainability in its attempt to define the Blue Economy as a marine based economy that:

Provides social and economic benefits for current and future generations, by contributing to food security, poverty eradication, livelihoods, income, employment, health, safety, equity, and political stability ... restores, protects, and maintains the diversity, productivity, resilience, core functions, and intrinsic value of marine ecosystems – the natural capital upon which its prosperity depends ... is based on clean technologies, renewable energy, and circular material flows to secure economic and social stability over time, while keeping within the limits of one planet.³⁰

While this definition encapsulates the major dimensions of the Blue Economy concept, it is yet to translate into a precise set of standards, measurement and indicators for monitoring and evaluating the health of the oceans over time. This lack of a precise set of standards is exacerbated by the vagueness of SDG targets and outcomes, including SDG 14. A review of the SDGs by the International Council for Science (ICSU) and International Social Science Council (ISSC)³¹ reveals a number of lapses in the targets and the outcomes of the SDGs. The review found that some of the outcome indicators are ambiguous, vague and not specific enough, that they lack clarity in their wording, and are insufficiently developed to be measurable.

This lack of precision makes it difficult to develop a practical set of principles to be implemented by public and private sector organisations, financial institutions, international agencies and civil society organisations to ensure conservation and preservation of the oceans.^{32,33,34} The Economist Intelligence Unit's Coastal Governance Index, which surveys 20 coastal countries, reveals huge disparities across countries in governance mechanisms, legislation and institutional provisions.³⁵ Some developing coastal countries surveyed did not have a domestic coastal management policy. Some developed countries had a coastal management policy in place, but no implementation strategy. Governance structures are not conducive to cross-country comparability, monitoring, evaluation and enforcement. Well-established regulation is still wanting, as is joint decision-making by all relevant stakeholders, and credible arbitration mechanisms – especially for conflicts in waters beyond the territorial borders of any specific country.

These challenges make it difficult to gather the data needed for scientific research that would inform policy formulation and implementation of the Blue Economy. The lack of adequate data also demonstrates a deficit in the level of research, knowledge and technology relating to the oceans. There is little awareness of the potential for growth in the ocean economy – for business development, employment creation, human wellbeing and, ultimately, for economic growth.³⁶

Blue Economy initiatives in selected IORA member states

The IORA consists of coastal states and islands across a number of continents. In Asia, IORA member states include Bangladesh, India, Pakistan, Maldives, Sri Lanka, Bhutan, Nepal, Malaysia, Thailand, Indonesia and Afghanistan. Afghanistan, Bhutan and Nepal are landlocked countries that access the oceans through India and Pakistan. IORA countries in Africa are Comoros, Kenya, Madagascar, Mauritius, Mozambique, Seychelles, South Africa and Tanzania. Iran, Oman, United Arab Emirates and Yemen are the Middle Eastern member countries of IORA. Countries and regions within the IORA have begun to implement several initiatives

to address the goals and objectives of the Blue Economy concept. These interventions are aimed at optimising the socio-economic potential of the oceans while ensuring their health. Blue Economy initiatives range from legal and governance programmes to capacity building and the establishment of research institutions to facilitate evidence-based policy formulation.

A number of IORA countries have initiated national and regional Blue Economy growth strategies that seek to foster regional cooperation and address some of the barriers to optimising the potential of the oceans. A few examples are discussed below.

Bangladesh

Bangladesh was the architect of the Bay of Bengal Partnership for a Blue Economy, which it proposed to South Asian countries in September 2014.³⁷ This partnership aims to ensure the sustainable development of oceanic resources. In Bangladesh, 30 million people depend on the ocean for their livelihood through fishing and transportation. The universities of Dhaka and Chittagong now offer training in oceanography to build capacity for sustainable development of the oceans, protecting the marine environment, and preserving marine bio-diversity.³⁸

India

India has a vast coastline of 7 500 km, 2 bn km² of exclusive economic zone (EEZ), and massive wealth in terms of living and non-living resources. The oceans contribute significantly to India's economy through fishing, non-human living resources, modernisation of maritime infrastructure, shipbuilding, and other related services through the private sector and other resources. India has established research and capacity-building institutions for technological advancement in studying and exploiting oceanic resources in sustainable ways.³⁹

Sri Lanka

Sri Lanka has targeted fisheries for food security and sustainable livelihoods, tourism for job creation, energy security through wind and biomass energy, shipping, and ports for economic growth and improved living standards.⁴⁰

South Africa

South Africa's ocean space of 1.5 m km² exceeds its land space of 1.2 m km². In 2014, South Africa launched Operation Phakisa, a well-designed agenda

that aims to unlock the socio-economic potential of its oceans over the next five years. The objective is to 'implement an overarching integrated ocean governance framework for sustainable growth of the ocean economy that will maximise socio-economic benefits while ensuring adequate ocean environmental protection within the next five years'.⁴¹ Phakisa means 'hurry up', indicating South Africa's sense of urgency to explore the economic potential of its oceans for much needed job creation, economic growth, and environmental sustainability in the use of its oceans.

The focus areas of Operation Phakisa are marine transportation and manufacturing, offshore oil and gas exploration, aquaculture, small harbour development, marine protection services and ocean governance, and coastal and marine tourism.⁴² To enable the achievement of intended outcomes in these areas, South Africa has earmarked skills development and capacity building, research, technology, and innovation as catalysts that could boost the realisation of its goals and aspirations, which are aligned with South Africa's National Development Plan (NDP) 2030.⁴³

The earmarked focus areas and enablers require extensive consultations and collaboration between several departments of state, an inter-departmental authorisations committee, legislative reforms, funding, coordinated industry-wide marketing efforts, preferential procurement procedures, and globally recognised monitoring and certification systems.⁴⁴ Several sites have already been earmarked for aquaculture, mining, shipping, fisheries and conservation projects. These are projected to create a large number of jobs and enormous ocean output, leveraging South Africa's wealth of oceanic resources. Further capacity building would be required, as well as the establishment of the requisite licensing and regulatory structures to ensure efficient and effective governance of South Africa's oceans.

These requirements are consistent with the situation in other IORA member countries, which require legislative reform to govern new dimensions of the Blue Economy concept. The concept itself needs to be standardised across IORA member countries with regard to capacity building, research, technological innovation and globally recognised certification. An additional challenge is a universally accepted set of indicators for measuring, monitoring and evaluating outcomes in the Blue Economy concept. Achievement of these challenges would require concerted effort from IORA countries and non-IORA countries. Furthermore, any agreed regional or country-level Blue Economy indicators should be able to speak to the target outcomes of SDG 14.

Proposed indicators for measuring sustainability in the Blue Economy

Sustainability within the context of a Blue Economy relates to three dimensions: economic, environmental, and social. This is meant to ensure socially inclusive and environmentally responsible use of the ocean economy, while optimising and maximising economic potential and value.

- **Economic dimension:** This relates to return on capital, namely, financial, physical, human and natural resource capital - in this case, the oceans. Measuring return on financial capital stands out as the easiest of the three forms of capital. Return on human and physical capital relates to productivity of capital and labour working in the ocean economy. Hence the value of the ocean economy as a proportion of total gross domestic product would be a feasible way of measuring the return on physical capital and human capital. The national income accounting record of some countries now includes a green gross domestic product (green GDP), which is aimed at monetising the environmental impact of output generation and growth. The green GDP represents a net change in GDP relative to the loss of resources. This includes changes in biodiversity, habitat, climate and other natural resources. By accounting for consumption and degradation of natural resources, the green GDP provides more complete accounting of the existing value of a country or community's natural wealth such as the oceans.⁴⁵ In close relation to this would be associated indicators, such as the level of ocean-based employment and the output of ocean related industries, e.g. fisheries, oil and gas, pharmaceuticals, seabed mining, and renewable energy sources, some of which require resilient offshore infrastructure. These possible measurements closely relate to the SDG targets of promoting economic growth (SDG 8), building infrastructure, promoting industrialisation, and fostering innovation (SDG 9).
- **Environmental dimension:** This is linked to SDG 14, i.e. 'Conserve and sustainably use the oceans, seas, and marine resources for sustainable development.'⁴⁶ Similar to the climate change indicators that emanated from the 2015 United Nations Climate Change Conference (COP 21) held in Paris, indicators are needed to measure and monitor the damage to ecosystems in the generation of economic output and in meeting target economic outcomes. This should not be too difficult to achieve, as a number already exist, such as controls on fishing and other non-human life forms.

- **Social dimension:** This relates to poverty reduction, job creation, achieving food security, ensuring healthy lives and promoting well-being for all ages, ensuring inclusive and equitable quality education, and promoting life-long learning opportunities for all. Gender equality, empowering all women and girls, ensuring availability and sustainable management of water and sanitation for all,⁴⁶ as well as all the other SDGs directly or indirectly.

A cursory glance through these three dimensions clearly reveals that the environmental dimension poses the strongest challenge in terms of universally acceptable definitions, agreeable and implementable policies, plans, targets and measurable indicators, monitoring, evaluation, regulation and enforcement, as well as the capacity of countries to inculcate these goals into national development plans and ensure they trickle down to sub-national levels of government.

In relation to the Blue Economy, the following needs to be done:

- Achieve a clear and universally acceptable definition of a Blue Economy.
- Break down this definition into a set of workable, tangible, measurable and consistent goals and targets at country, regional and global levels.
- Formulate regulatory and legislative controls and rules to govern the various industries and sectors of economic activity in the ocean economy, and in the process ensure a level playing field that prevents regulatory and economic arbitrage between countries.
- From the regulations, develop universally acceptable standards, guidelines and best practice for monitoring, evaluation and enforcement.
- Establish mechanisms for conflict resolution and redress among countries, especially in waters beyond the territorial borders of countries.
- Design country level capacity building programmes to facilitate policy planning, design, formulation, implementation, monitoring and evaluation.
- Cooperate regionally to exchange knowledge and experiences through which any needed changes can be made to existing frameworks.

Implementation of these Blue Economy measures is the responsibility of all stakeholders, including both public and private sector organisations. These measures would further define the responsibilities, rules and regulations that would govern the operations of both government, private business and industries that exist in the ocean economy.

Conclusion, policy recommendations and the way forward

This chapter discusses the concept of sustainability within the context of the Blue Economy. The chapter begins by first discussing the evolution of sustainability theory and how it relates to the Blue Economy. It then outlines: the nature of the ocean economy and its linkages to sustainable development; challenges posed by the ocean economy to the realisation of SDG 14; institutional barriers to the achievement of the Blue Economy; Blue Economy initiatives in selected IORA member states; possibilities for measuring sustainability in the Blue Economy. In conclusion, it provides a few policy recommendations.

Consistent with the goals of the Rio+20 summit on sustainable development, the aim of a Blue Economy is to ensure that economic growth is enhanced through the ocean economy in a manner that is socially inclusive and environmentally responsible. This goal of the Blue Economy has three key dimensions: economic, social and environmental sustainability. The economic potential of the oceans should be optimised in a way that emphasises social inclusion and guarantees environmental responsibility. Several Blue Economy initiatives have been initiated in IORA member countries. Action and reform is still required: legislative reform should be standardised to avoid any regulatory arbitrages between member countries; industry-wide marketing efforts should be coordinated; research is needed to facilitate evidence-based policy formulation, globally recognised monitoring, evaluation and certification systems. These developments will come further down the line as countries and regions develop and consolidate their respective Blue Economy strategies.

In light of SDG 14, there is no need for a new set of goals, targets and outcomes. However, there is a need to further fine-tune these existing goals, targets and outcomes to make them more tangible, quantifiable, measureable and enforceable. This would enable monitoring and evaluation over time. In this regard, several 'soft' and 'hard' challenges inhibit the realisation of the Blue Economy and blue growth. These challenges need to be addressed in the manner discussed above. The challenges partly explain why the SDGs, as a whole, are yet to inform development programmes worldwide. The strongest challenges exist in developing countries.

'Soft' challenges include: reaching international consensus on targets, indicators and outcomes; establishing criteria for assessing country-level performance based on these indicators; installing the requisite regulatory and legislative framework to govern economic activities in the oceans; and avoiding regulatory arbitrage between countries. Uniform standards and guidelines for licensing and best practice that ensures sustainable ocean health also need to be developed. Active exchange of knowledge is called for, along with cross-pollination of ideas and capacity building to improve standards and guidelines over time.

'Hard' challenges to realising a sustainable Blue Economy and prosperous future for all include: physical port infrastructure and its interconnected rail, road and telecommunication infrastructure; security cooperation; structures to combat crime; information sharing across borders and between governments; trade infrastructure; conflict resolution between neighbours such as India and Pakistan, especially in waters beyond the territorial boundaries of any specific country; inter-regional and intra-regional value chain linkages for trade development.

The ocean economy holds great potential for economic growth and development that could benefit both coastal and non-coastal nations. However, much needs to be done to ensure that the health of the oceans is not compromised.

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CHAPTER 5

Integrating a Gender Perspective into the Blue Economy

Neera Verma

Introduction and context

It is widely accepted today that the world is gender unequal and this inequality is hampering economic development in both the short and the long-term. As gender equality is both a fundamental principle of democracy and essential to the process of sustainable development, there can be no genuine sustainable human development without gender equality.¹

There is a strong case for promoting gender parity; women represent one half of the world population and therefore also one half of its potential. Evidently, they deserve equal treatment and equal access to health, education, economic participation, and political power. Moreover, gender parity is equally fundamental to whether and how societies thrive. Ensuring proper development and appropriate use of one half of the world's talent pool positively impacts competitiveness and economic growth. At the same time it increases the probability of building more stable societies.

It is important to recognise that gender parity will be promoted only when it involves not only equality of opportunities for men and women but also equality of outcomes. Women's reality and their experiences are often different from that of men. The goal of gender equity, sometimes called substantive equality, goes beyond equality of opportunity: it requires transformation. It recognises that women and men have different needs, preferences, and interests and that equality of outcomes may necessitate different (instead of same or equal) treatment of men and women. Therefore any approach to promote gender equity warrants assessment of all development initiatives and policies in terms of their impact on gender relations.

Since Boserup's² pioneering work on woman's role in economic development, there have been several empirical studies which establish that gender equality

improves economic efficiency, increases the productivity of both present and future generations, and generates significant economic dividends. Of course, these dividends may vary, depending on the circumstance and challenges that different economies are facing.

For example, it is estimated by a recent study³ that gender parity in the economic sphere can generate additional GDP to the tune of US\$526 billion in Japan, US\$285 billion in Germany, US\$240 billion in the UK and US\$120 billion in USA. Similarly another study by McKinsey & Company⁴ indicates an increase in China's GDP by US\$2.5 trillion and that of North America & Oceania by US\$3.1 trillion by 2020 if existing gender gaps in these regions could be closed.

The latest empirical study by the European Institute for Gender Equality⁵ establishes that 'gender equality boosts economic growth'. Based on econometric modelling of a broad range of potential impacts of improved gender equality in the EU, the study says that, if the EU made greater efforts to improve gender equality, more jobs would be created, GDP per capita would increase and society would be able to adjust better to the challenges associated with ageing populations. The evidence confirms that improvements to gender equality would generate up to 10.5 million additional jobs by 2050 and that the EU employment rate would reach almost 80 per cent. EU gross domestic product (GDP) per capita would also be positively affected and could increase by 6.1 to 9.6 per cent (which amounts to €1.95 to €3.15 trillion) by 2050.

The study concludes that

gender equality is good for the economy and it cannot be disregarded if the EU wants to achieve sustainable and inclusive growth. For far too long, gender inequalities have been limiting women's economic opportunities and we now have proof that gender equality is crucial for the *entire economy*.⁶

Several studies also suggest a positive correlation between female labour participation and economic growth, while restricting women's entry into the labour market obstructs economic growth. The International Monetary Fund (IMF) has estimated GDP losses of up to 27 per cent in any given region due to lack of women in the work force.⁷ Similarly, Australia loses US\$8 billion annually for undergraduate and postgraduate women who do not enter the workforce. Regions of East Asia and Pacific are reported to annually lose US\$42 billion to US\$47 billion because of women's limited participation in labour markets.⁸ Similar sizable costs are reported by the World Bank for the Middle East, North Africa, and Sub-Saharan Africa.⁹

Further, recent studies suggest that a decline in the gender gap has supported economic growth in Europe over the past decade and has great potential for future growth as well. Again it is estimated that a 10 per cent increase in the female/ male

ratio of workers in India can lead to a GDP increase of 8 per cent, and if African women were given equal access to agricultural inputs, agricultural outputs could increase by up to 20 per cent.¹⁰

Table 5.1 shows the labour force participation rate (LFPR) for both the male and female labour force for select Indian Ocean Rim countries.

Table 5.1: *Male and Female Labour Force Participation Rate (Percentage of Population Ages 15+) (Modelled ILO estimate): Selected Indian Ocean Rim Countries¹¹*

Sr. No	Country	Female LFPR		Male LFPR		Gender Gap	
		1990	2016	1990	2016	1990	2016
	World	52.38	49.5	80.61	76.2	28.23	26.7
1	Australia	52	58	76	71	24	13
2	UAE	25	42	91	91	66	49
3	Oman	17	30	81	86	64	56
4	Yemen, Republic	16	26	74	73	58	47
5	Kenya	70	62	80	72	10	10
6	Tanzania	87	74	92	83	5	9
7	Comoros	27	36	81	79	54	43
8	Mozambique	85	82	81	75	-4	-7
9	Madagascar	84	84	89	89	5	5
10	Mauritius	38	47	81	75	43	28
11	South Africa	41	46	68	61	27	15
12	Iran, Islamic Republic	10	16	81	73	71	57
13	Bangladesh	62	43	89	81	27	38
14	India	35	27	85	79	50	52
15	Thailand	76	63	87	80	11	17
16	Sri Lanka	46	30	79	75	33	45
17	Malaysia	43	49	80	78	37	29
18	Singapore	51	58	79	76	28	18
19	Indonesia	50	51	81	84	31	33
20	Somalia	35	33	77	76	42	43

It is evident that there was a 28.2 percentage point difference between male and female LFPR for the world in 1990, which has marginally come down to 26.7 per cent in 2016. Three major inferences can be drawn from this table: One, except for Mozambique, male LFPR is higher as compared to female LFPR in all the sample countries; two, this gender gap (to the disadvantage of women) ranges from a low of 5 per cent (Madagascar) to as high as 57 per cent (Iran) in 2016; three, female LFPR has gone down in 2016 vis-à-vis 1990 in 8 out of the 20 sample countries.

It is pertinent to note that there does not seem to be a clear, direct relation between female LFPR and per capita income, though indirectly a higher female LFPR may be promoting growth as argued by the above-mentioned studies. However, Table 5.1 does suggest that many of the countries, where gender gap in LFPR is around 50 per cent, are low income, predominantly Muslim, and mostly African countries. The same is corroborated by the ratio of female to male LFPR in Table 5.2 below, which is lower than the world average for these countries. India stands out as an exception here in that it is an Asian and predominantly Hindu country but has a high gender gap of 52 per cent and a very low ratio of female to male LFPR at 34 per cent (second lowest, next only to Iran).

Table 5.2: *Ratio of Female to Male LFPR (Percentage) (Modelled ILO Estimate): Selected Indian Ocean Rim Countries¹²*

Sr. No	Country	1990	2016
	World	68	68
1	Australia	69	83
2	Bangladesh	70	53
3	Comoros	34	45
4	India	41	34
5	Indonesia	62	61
6	Iran, Islamic Republic	12	22
7	Madagascar	94	94
8	Malaysia	54	63
9	Mauritius	47	63
10	Mozambique	106	109
11	Kenya	87	86
12	Oman	21	35
13	Seychelles	–	–

Sr. No	Country	1990	2016
14	Singapore	64	76
15	South Africa	60	76
16	Sri Lanka	57	40
17	Somalia	46	44
18	Tanzania	95	89
19	Thailand	87	89
20	UAE	27	46
21	Yemen	22	35

The overall global gender gap index (composed of four sub-indices: economic opportunity and participation, educational attainment, health and survival, and political empowerment) and the economic opportunity and participation index in Table 5.3 shows that although there are exceptions such as Madagascar, Mozambique, Kenya and Tanzania, in general the higher score of a country in terms of economic participation and opportunity is associated with a higher per capita income and vice-versa.

Table 5.3: *Per Capita Income and Global Gender Gap Index 2017: Selected Indian Ocean Rim Countries¹³*

Sr. No	Country	Per capita GDP (PPP) 2015 USD	Global Gender Gap Index		Economic Participa- tion and Opportunity	
			Rank	Score	Rank	Score
1	Australia	46 270	35	0.731	42	0.724
2	Bangladesh	3 339	47	0.719	129	0.465
3	India	6 104	108	0.669	139	0.376
4	Indonesia	11 057	84	0.691	108	0.610
5	Iran, Islamic Republic	17 370 (2014)	140	0.583	140	0.357
6	Madagascar	1 465	80	0.692	48	0.716
7	Malaysia	26 950	104	0.670	87	0.654
8	Mauritius	20 085	112	0.664	113	0.595
9	Mozambique	1 192	29	0.741	17	0.789

Sr. No	Country	Per capita GDP (PPP) 2015 USD	Global Gender Gap Index		Economic Participa- tion and Opportunity	
			Rank	Score	Rank	Score
10	Kenya	3 088	76	0.694	44	0.720
11	Oman (2016)	39 971	133	0.612	126	0.483
12	Singapore	85 382	65	0.702	27	0.752
13	South Africa	13 195	19	0.756	89	0.652
14	Sri Lanka	11 762	109	0.669	123	0.521
15	Tanzania	2 672	68	0.700	69	0.674
16	Thailand	16 340	75	0.694	24	0.767
17	UAE	69 970	120	0.649	130	0.459
18	Yemen	2 820	144	0.516	141	0.345

Thus, it can be concluded from the above analysis that gender inequality across the countries is real and significant both in overall and economic terms. In view of the growing recognition of the Blue Economy paradigm for sustainable development and the significance of gender parity for economic growth and sustainable development, it is crucial to integrate women, effectively and adequately into the Blue Economy.

The concept of the Blue Economy

As a concept the Blue Economy has recently shot into prominence with Gunter Pauli's work¹⁴ and the 2012 Rio+20 UN Conference on Sustainable Development¹⁵ and is fast emerging as an alternative strategy for sustainable development. Replacing the landlocked vision of green economy, the Blue Economy concept treats oceans as the centre and views the situation from the seaward side where a sustainable ocean economy integrates with, and is inclusive of, the green economy. The observation by Borgese, founder of the International Ocean Institute, Malta, that 'if before you saw the sea and the sea floor as a continuation of the land, you now see the land as a continuation of the sea' depicts the current vision of the Blue Economy. Thus, the Blue Economy can be regarded as the integration of ocean economy with the principles of social inclusion, environment sustainability, and innovative, dynamic business models.¹⁶

A word of caution is important. We must guard against ‘an emerging train of thought which promotes Blue Economy as a way of deriving greater revenue from the ocean. The danger of this thinking is the risk of even greater over-exploitation of the oceans’ limited resources.’¹⁷ Sustainability is at the core of the Blue Economy paradigm and a sustainable Blue Economy is one that provides not just economic but *social benefits* for present and future generations. It is characterised as inclusive, marked by stakeholder participation; well informed, precautionary and adaptive; accountable and transparent; holistic, cross-sectoral, and long-term; and innovative and proactive.¹⁸

In brief, we can say that *Blue Economy is a sustainable ocean economy, where economic activity is in balance with the long term capacity of ocean ecosystems to support this activity and remain resilient and healthy.*¹⁹

What is the size of the Blue Economy today? The estimates of contribution to GDP are at a nascent stage and only indicative, due to the differences in conceptualisation and classifications across different countries. Kildow and McIlgorm²⁰ make a strong case for the estimation of the ocean economy. They argue that an idea about the size, nature, and growth will provide a factual basis for governments to track, regulate and adopt relevant policies.

Though strict comparisons are not yet possible, it is estimated that, in Malaysia, Indonesia, and Iceland, the Blue Economy is contributing between 20–26 per cent of the GDP, while in France, Canada and Mauritius, its contribution to GDP is about 10 per cent.²¹ In fact, the Seychelles and Mauritius are known as Blue Economy driven economies because of their heavy dependence on oceans.

Further, employment generation has also been impressive in recent years in the Blue Economy sectors of China, USA, UK, Canada, and France as shown in Table 5.4. This highlights the importance of Blue Economy for achieving inclusive and sustainable growth in coastal countries.

Table 5.4: *Employment in Blue Economy*²²

Sr. no	Country	Year	Number
1	Canada	2006	171 365
2	China	2010	9 235 000
3	France	2009	459 358
4	UK	2006	548 674
5	USA	2010	2 770 000

Globally, in the coming years, every sector of the Blue Economy will be affected by technological advances ranging from sub-sea engineering and technology, satellite

technologies and autonomous system, to biotechnology and nanotechnology. The Organisation for Economic Cooperation and Development (OECD)²³ has projected growth in the ocean economy under three different scenarios by the year 2030 - (i) unsustainable growth, (ii) business as usual, and (iii) sustainable growth. The gross value add in the ocean economy is projected to grow from US\$1.5 trillion in 2010 to US\$2.8 trillion, US\$3 trillion and US\$3.2 trillion respectively under the three scenarios.²⁴

Table 5.5 below illustrates scenario two wherein ocean-based industries will be doubling their contribution to global value added (GVA) in 2030 in comparison to 2010. The top three sectors in terms of addition to GVA are tourism, ports and fisheries. The Indian Ocean region has great potential in these sectors given its geography, demography, and natural resource endowment. Hence, countries in this region should focus on development of micro level strategies, as topmost priority, to take advantage of this projected growth.

Table 5.5: *OECD Projections of Changes in the Ocean Economy by 2030 under Business as Usual Scenario*²⁵

Industry	Share of Ocean Economy (percentage)		Change in Ocean Economy Share (percentage)	Gross Value Added (US\$ billions)		Gross Value Added Increase (US\$ billions)
	2010	2030	2010–2030	2010	2030	2010–2030
Tourism	25	26	1	375	780	405
Ports	13	16	3	195	480	285
Fisheries	6	11	5	90	330	240
Marine Renewables	1	8	7	15	240	225
Shipping	20	17	-3	300	510	210
Offshore Oil and Gas	34	21	-13	510	630	120
Aquaculture	1	1	0	15	30	15
TOTAL	100	100		1500	3000	1500

In brief, it is clear from the foregoing analysis that the Blue Economy paradigm is going to be an influential idea for the development of the global economy in both the near and distant future. The next pertinent question is: What are the implications of this economic model of sustainable development for gender parity and women empowerment, especially in the economic sphere?

Gender perspectives in the Blue Economy

Although all seventeen UN Sustainable Development Goals (SDGs) are interrelated and mutually reinforcing, the two directly relevant goals in this context are Goal 5 (*Achieve gender equality and empower all women and girls*) and Goal 14 (*Conserve and sustainably use the oceans, seas and marine resources*).

The success of the Blue Economy paradigm in promoting equitable and inclusive economic growth is inextricably linked to the inclusion and participation of women in this expanding ocean economy. There is a need to incorporate a 'feminist perspective' in this paradigm from the beginning. It is pertinent to note:

A feminist perspective seeks to reshape gender relations by questioning the dominant discourse and those who set its terms. Gender issues thus focus not only on women, but on the relationship between men and women, their roles, rights and responsibilities, while acknowledging that these vary within and between cultures as well as by class, race, ethnicity, age, and marital status.²⁶

However, the presence of women in the majority of Blue Economy sectors is very small, especially in the Indian Ocean region. Further, this participation is mostly in traditional, low value addition activities involving low skill-sets, often informal and unaccounted for, and gender discrimination in terms of wages and work conditions, including unpaid care work, is pervasive. Adoption and growing acceptance of the Blue Economy paradigm presents both an opportunity and a challenge to woman empowerment. If gender parity is integrated into the paradigm right now, as a part of the 'hard core' for sustainable development, then it can go a long way in promoting gender equality and further step up the rate of growth as evidenced by several theoretical and empirical studies discussed earlier in the chapter. However, if the growth of Blue Economy takes place under the present institutional framework and discriminatory environment, the converse will be true. We shall again be dealing with the issues related to 'mainstreaming of women' as an afterthought if the later scenario emerges. Hence, it is imperative that due attention is given to the gendered implications of the Blue Economy growth and it is not left to the development of appropriate 'positive heuristics' to later generate gender-parity promoting theories in the 'protective belt' of this paradigm.

As noted earlier, ocean related economic activities across the world are expanding significantly. However, as Kildow and McIlgorm²⁷ have pointed out, there is no unanimity about the definition, classification, and scope of the Blue Economy, and it varies from country to country. Even the concept of Blue Economy is not defined consistently, as is evident in this Handbook. For instance, there are 14 different definitions in 14 different countries.²⁸ Similarly, taxonomy and scope of the ocean

economy is also different across countries. For example, in the USA, it is classified into six main sectors, but it is divided into 18 sectors in the UK. Further, seafood processing is not included in ocean economy in the UK, but France includes it along with electricity generation such as thermal power and nuclear power – a practice not followed so far in other countries.

Differences among nations in classification standards and scope of the blue/ocean economy arise also on account of whether public sectors are included or not, and whether new ocean industries are combined or not. In brief, ocean economies across countries are not strictly comparable because of the differences in classification standards and scope. Many attempts at classifying economic activities under the purview of Blue Economy have been made. One detailed classification has been attempted by Park and Kildow,²⁹ who have divided it into 12 sectors as reproduced in Table 6.

Table 5.6: *Classification System of the Ocean Economy*³⁰

Sr.	Sectors	Definition	Categories
1	Fisheries	The economic activity related to the production, processing and distribution of seafood.	1) Fishing 2) Aquaculture 3) Seafood processing 4) Seafood distribution and wholesale
2	Marine mining	The economic activity related to the production, extraction and processing of non-living resources in seabed or seawater. But it doesn't include offshore oil & gas.	1) Marine aggregates (limestone, sand, gravel) 2) Seabed resources 3) Salt 4) Seawater dissolved minerals extraction
3	Offshore oil & gas	The economic activity related to the exploration and production of offshore oil and gas, includes operating and maintaining equipment related to this activity. It doesn't include building offshore platforms, equipment and OSVs.	1) Oil and gas E&P 2) Offshore supply services
4	Shipping and Port	The economic activity related to the transportation of freight and passengers through the ocean and river, and related to operation and management of port.	1) Passenger transportation 2) Freight transportation 3) Shipping business services 4) Port development 5) Port O&M (storage, load and unload, trucking, etc.)

Sr.	Sectors	Definition	Categories
5	Marine leisure & tourism	The economic activity related to the marine and coastal leisure and tourism, which includes eating & drinking places, hotels & lodging places, marinas, marine sporting goods retailers, zoos, aquarium, recreational vehicle parks & campgrounds and so on.	1) Eating & drinking places 2) Hotels & lodging places 3) Marinas, marine sporting goods retailers, zoos, aquarium, recreational vehicle parks & campgrounds 4) Marine festival, etc.
6	Marine construction	The economic activity which includes construction in the ocean and related to the sea.	1) Marine construction (seabed cable, pipeline) 2) Marine related to construction (ports, bridges, etc.)
7	Marine equipment manufacturing	The economic activity which includes manufacturing of marine equipment and materials, such as various machinery, valve, cable, sensor, ship materials and so on (no building, repair and/or conversion and supply services).	1) Machinery, valve, cable, sensor, ship components 2) Research equipment 3) Others
8	Ship building & repair	The economic activity related to the building, repair and maintenance of ships, boats, offshore platforms, and OSVs.	1) Ship & boat building 2) Ship & boat repair and maintenance 3) Offshore platform & OSV building 4) Offshore platform & OSV repair and maintenance
9	Marine business services	The economic activity related to services to support ocean industry like finance, consulting, technical services and so on.	1) Finance & Insurance, marine consulting 2) Rental 3) Technical services 4) Inspection 5) Ocean engineering, S/W service 6) Labour supply services 7) Others
10	Marine R&D and education	The economic activity which is related to research, and development, education, training.	1) Research and development 2) Education and training
11	Marine administration	The economic activity related to defence, coast guard, security, navigation and safety, coastal & marine environmental protection by government and public or private organization.	1) Defence, coast guard, security 2) Navigation and safety 3) Coastal & marine environmental protection 4) Organization (government, public organization, NGO)

Sr.	Sectors	Definition	Categories
12	Others	The economic activity which is not classified elsewhere. It also includes economic activity related to development of the ocean resources, which are ocean renewable energy, marine living resources, seawater and spatial, but just enter into the early commercial stage.	1) Ocean energy (tidal, wave, OTEC, offshore wind) industry 2) Marine bio industry 3) Seawater desalination 4) Marine CCS 5) Others which are not classified elsewhere

Data availability on the Blue Economy as well as on women's participation is thin. Nevertheless, available statistics suggest that women have significant participation in fisheries and they are growing more empowered over time. Other sectors where they have some presence are marine leisure and tourism, marine education and marine administration. In all other sectors women are almost invisible in the developing countries of the Indian Ocean region.

Traditionally, women have been participating in fisheries and aquaculture in all coastal countries, but the challenge is to upgrade their skills, convert their peripheral or supporting role to independent roles, provide easy, adequate and timely credit, and create systems for technical and marketing support to increase their value addition. Further, it is very important to initiate women's participation in emerging modern subsectors of the Blue Economy on an equal footing to men. This is easier said than done; the challenges are not purely economic but have cultural, social, and political dimensions as well.

In light of the fact that gender parity is globally recognised today as the one of the most significant socio-economic development indicators of a progressive society – and that the Blue Economy is arguably becoming the most popular development paradigm of our times – it is important and relevant to examine the present contribution of women in the Blue Economy and to identify potential economic activities which may lead to greater participation by women. Accordingly, in the following sections, we make an attempt to analyse the current sector-specific and the region-specific status of women in the Blue Economy and the policy initiatives required for further integration of women into the Blue Economy.

(a) Women in the fisheries sector

The fisheries sector is an important source of livelihood for millions of people around the world. Fish are a rich source of protein as well as a source of income for large number of families and communities in developing countries. While the Food and Agriculture Organization of the United Nations (FAO) estimated in 2000

that 35 million people across the world were directly engaged in fishing and fish farming, the number swells to 120 million if indirect dependence is also added.³¹ Capture fisheries and aquaculture together generate work for about 200 million people, 70 per cent of whom work in the traditional, small-scale sector. The highest numbers of fishery and aquaculture workers are in Asia (85 per cent of the world total), followed by Africa (7 per cent).³²

Authentic and systematic statistics on the number of women involved in fisheries-related work is almost non-existent, although it is well known that women have played an important role in this sector historically. The seafaring activity of women may be limited, but they are known to carry out varied activities in the fisheries and in fishing communities all around the world. Inland fishing and aquaculture, seafood processing, preparatory work such as mending nets, taking care of the family, and strengthening of fishers' movements and organisations are some of the important roles played by women in fishing.

Women's most visible role – in small-scale and industrial fisheries – is in post-harvest, processing, and marketing. For example, it is the women who market 80 per cent of total seafood in West Africa. Again, the proportion of female workforce in aquaculture is as high as 80 per cent in Vietnam, and 60 per cent of fish processing workers in India are women. Although the majority of women's work is still in traditional activities, they are entering into the male dominated domains. The number of women fishing on their own and owning boats is steadily increasing in many developing countries such as Cambodia, Thailand, and Bangladesh. For example, in Bangladesh 60 per cent of fish farmers are women. However, all such gender statistics are an understatement and do not reveal the true picture of the contribution of women in fisheries and aquaculture. Unfortunately, available data fails to capture the multidimensional nature of the activities of fisherwomen and their contribution remains largely unrecognised and unremunerated. Consequently, policies often fail to keep the gender perspective in mind.³³

It is an unfortunate reality that societies in most of developing countries do not attach much value to women's work and consider it to be low-value activity. This socio-cultural attitude leads to the reinforcement of gender discrimination through lack of adequate access to credit, skill and training, modern technology, etc. It has been found, for instance, that women fish farmers incur greater post-harvest losses as they are usually unaware of modern processing and storage techniques.

However, there is also a catch to modernisation and mechanisation. There are indications that profitable mechanisation of small-scale fisheries production has led to the substitution of women fishmongers by male fish traders; traditional boats have been replaced by motorised vessels, also displacing women. Studies also show that when improved fish preservation and processing facilities are made available,

men engaged in capturing fish begin to compete with women and turn to these post-harvest activities. Although fair competition may be good for the growth of fisheries, necessary safeguards need to be incorporated into the modernisation programmes to prevent displacement of the (often socially and culturally marginalised) female workforce.³⁴ Gender discrimination is also prevalent in the industrial processing sector in the form of lower wages, gender insensitive work conditions, and insecurity of jobs. For example, women from fishing communities in India who became wage earners in the seafood export industry were found to be paid less than men, and were away from their homes for longer periods, making it more difficult for them to fulfil their domestic roles.

Opportunities in aquaculture also need to be analysed from a gender perspective. Property rights of women tend to be either absent or ill-defined or not effectively enforced in many Asian and African communities. Lack of inheritance rights reduces women's motivation to play an effective and bigger economic role in family business. Moreover, the introduction of new practices in aquaculture (e.g. cage and pen culture) may deprive women of water used for other domestic activities such as drinking, washing dishes, and bathing. If aquaculture reduces water availability from wells and ponds, women may have to look for other, more distant sources and this may be a demotivating factor for their involvement in the expansion of such activities.³⁵ Below are two case studies related to the role of women in fisheries and aquaculture.

CASE STUDY 1: **The Role of Women in Fisheries**³⁶

An empirical study on role of women in fisheries in 13 EU countries was undertaken by MacAlister Elliott and Partners Ltd (MEP) in 2002. The study addressed two interlinked community priorities: the promotion of social and economic cohesion and the promotion of equal opportunities and rights for men and women. The aim was to facilitate the integration of these two Community priorities to the fishery sector, i.e. gender mainstreaming in fisheries development.

The study finds that despite all the cultural and economic diversity within the EU, the position and perception of women regarding the fisheries sector has a considerable degree of commonality. Women feel unwelcome in the seagoing fishing sub sector, but have little interest in participating anyway. In aquaculture also women feel discriminated against, but to a much lower extent in comparison to sea going activities. Processing is the one sub sector where women are over-represented, but mainly because they predominate in low-grade unskilled jobs. Women have made significant inroads into the management/administration segment, both of which are more rewarding and viewed in a more positive light. Finally, the role of women as support to

seagoing spouses was found to be both very important and highly undervalued by the fishing community.

In view of the findings, a number of practical recommendations for subsequent action by the EU and Member States were made:

- **Fishing:** Women on the whole don't wish to go to sea and aren't particularly wanted, so whilst ensuring that women can participate if they so wish (i.e. no unfair barriers), there is little point in pushing for greater involvement.
- **Aquaculture:** Barriers are lower and opportunities significant in this sub-sector. Focussed training should enhance access to technical and managerial positions viewed as desirable by women.
- **Fish Processing:** There is clearly discrimination in processing, but it is perhaps best to help women exit the industry rather than concentrate on upgrading what are likely to always be low grade jobs. So in non-FDAs (Fishery Dependent Areas), there is little justification for special support but in FDAs, there is justification in assisting women to take "ownership" of some added-value or processing functions so that they can maximise and upgrade their shore based role as co-managers of family businesses.
- **Administration:** Environmental and resource management issues are potential key themes for women's continually expanding involvement, and so training should focus on these as well as core management subjects. Public sector administration and research were identified as key areas where women's involvement and equality are relatively high, and probably where there are the best prospects for further enhancement.
- **"Collaborating spouses":** The principal recommendation of the report was acknowledging, upgrading and expanding women's support role in the sector. A package of support should be devised to promote the enhancement of this role for women, possibly containing specific support for (a) enhanced mutual support networks, (b) assistance with improved communication (especially internet-based), (c) public awareness campaigns to enlist wider community support (especially from fishermen), (d) training including a mix of specific local technical and managerial courses plus IT skills to encourage women to become the internet managers for their family enterprises. This would reinforce the networking capabilities of shore-based women as well as generate transferable skills in a marketable area.

CASE STUDY 2: TRY Oyster Women's Association in The Gambia³⁷

The case of the TRY Oyster Women's Association in The Gambia illustrates multiple linkages of the Blue Economy approach ranging from social inclusiveness to capacity building, job creation, and environmentally sustainable management of small-scale operators. Under the Cockle and Oyster Fishery Co-management Plan for the Tanbi Wetlands National Park of 2013, TRY is the first women's association in sub-Saharan Africa to be granted exclusive use rights to a fishery by a national government. Founded in 2007, the association has moved since then, from small gatherings of 40 oyster harvesters in one community in the Tanbi to an established group with organized leadership and more than 500 members from 15 communities in the Greater Banjul area. Harvesters are grouped into cooperatives, in which they exchange sustainable oyster harvesting techniques and receive training in small-scale enterprise development (e.g., financial literacy, training and procurement of loans).

These cooperatives have ensured access to appropriate equipment and technologies; set higher standards for working and sanitary conditions; and helped to coordinate the processing, packaging, and marketing of oysters, which has resulted in more than doubling of the price-per-kilogram for oysters. The cooperatives have also promoted reforestation of local mangroves as members have planted 33.5 hectares of mangroves that are thriving now, improved education for a number of children of TRY members, and educated the local population about the benefits of environmentally responsible resource management.

TRY has empowered the oyster women. They have realized the value of cooperation in working toward a common goal. Previously, they had worked as individuals in isolation in poor and worsening economic, social, and environmental conditions. They are now working in solidarity as legally recognized leaders and participants in decision-making for the sustainable management of natural resources in their communities and nationally.

The key factors contributing to TRY's success have been: a participatory process with extensive stakeholder consultation, starting with the women harvesters and including all levels of local and national government; an adaptive management approach based on research of local ecological knowledge and scientific knowledge conducted with stakeholders; research findings and implementation challenges reviewed annually by stakeholders; and inter-ministerial collaborations.

TRY's experience has demonstrated the progress that can be made when win-win situations are identified. The oyster and cookie fisheries industry in The Gambia has not included strategies, management plans or monitoring schemes of the Department of Fisheries due to the low economic returns and limited government resources. The women oyster harvesting communities were vulnerable, marginalised and without a voice. Through rights-based co-management, TRY and its members are now sustainably

managing the country's shellfish resources and associated ecosystems at very little cost to the government, while also improving their own livelihoods.

In general, it can be said that while the contribution of women in the fishery sector differs across cultures and regions, the common factor is that it is generally treated as unproductive and insignificant. However, the fact is that women's participation has strengthened fish worker's organisations and broadened their agendas. Women have brought in a community perspective to fisheries issues through their concern for quality of life and focus on issues related to education, safety, health, and sanitation. Keeping in view the above challenges, FAO³⁸ specified the following targets for itself for the period 2008–2013 in order to integrate gender equity in its programmes for fisheries and aquaculture:

■ **Women's empowerment**

Use women's empowerment as an indicator in assessing the contribution of small-scale aquaculture to sustainable rural development.

■ **Aquaculture training**

Incorporate gender concerns in information and other tools for aquaculture development, and increase women's participation in training in management, seed production, and entrepreneurship.

■ **Fisheries research and management**

Improve the ratio of men and women trained or participating in capacity building in fisheries research and management.

■ **Global conference**

Include gender as a thematic area in FAO's Global Conference on Aquaculture 2010.

Thus women have always been present in this sector but the need is to record and quantify their contribution and bring about qualitative changes in their role and status in terms of recognition, removal of entry barriers, credit and skills, wage parity, and conducive work conditions. In short, gender parity will be promoted if women are provided an enabling environment and a level playing field.

(b) Women in the maritime industry

In broad terms, the maritime industry comprises all enterprises engaged in the business of designing, constructing, manufacturing, acquiring, operating, supplying, repairing, and/or maintaining vessels and their components. It also includes

management and operation of shipping lines, stevedoring and customs brokerage services, shipyards, marine railways, marine repair shops, shipping and freight forwarding services. This means that the industry is very wide and has strong employment potential.

However, the sector which holds the greatest potential for women in manufacturing is marine biotechnology. Marine Biotechnology explores the oceans to develop pharmaceutical drugs, chemical products, enzymes and other industrial products and processes. It also plays a vital role in the advancement of biomaterials, healthcare diagnostics, aquaculture, seafood safety, bioremediation, and biofiling, a term associated with accumulation of algae and microorganisms on wet surfaces. Marine biotechnology is still in its infant stage. We have been familiar with red, green, and white biotechnology to describe biotech approaches for pharma, agriculture, and microbial products, but blue biotechnology is a newcomer. It has opened new vistas for the exploration of life-saving drugs, new industrial products and processes, and environmental monitoring devices.

No doubt the number of women in scientific research is increasing, but where academia crosses into the industry, men still rule. It is a well-worn cliché that men dominate the top ranks of the biotech industry. But over the past decade some extraordinary women have put that cliché to the test and the number is growing. Now that the initial barriers to entry have been loosened, women can be educated, trained, and supported to take a lead in marine biotechnology.

Further, shipping and port services play an important role in any country's development. Countries with good maritime facilities not only promote their own trade but can also generate additional revenue by extending port facilities to other landlocked countries. Singapore is a perfect example in this case as it has emerged as a very busy port for shipping. Clearly, the maritime industry has a great potential for future growth. For example it is estimated that the cruise liner industry, which is only one part of the maritime industry, contributed globally an income of US\$183.3 billion, 4.2 million jobs, and direct capital expenditure worth US\$29.4 billion. However gender statistics of this contribution is not available.³⁹

In brief, despite expansion and growth, employment of women in almost all sub-sectors of Blue Economy is negligible. The International Transport Workers' Federation estimates that only 2.2 per cent of the world's maritime workforce is made up of women.⁴⁰ It is time to change this statistic by enhancing opportunities for women to be educated and gain experience in maritime activities. Equally important is changing the culture in the maritime sector to reduce the prejudices women encounter on a daily basis. Fortunately, there is evidence that efforts to do so are yielding results, even though building experience among women in the sector is no easy task. The tourism sector is the only exception where women make up a large proportion of the workforce.⁴¹ In entrepreneurship, women are almost

twice as likely to be employers in the tourism industry as in other sectors, and often employ more women than men. However, there is no data available pertaining only to marine tourism. Hence no objective assessment can be made with regard to contribution of women in sea-related tourism, but perceptually it is indicated that it may hold a promising future for women as is the case in tourism in general.

More women can also be facilitated to enter business services, education, research and development, and administration sectors of the marine economy. Marine related banking and financial services is a specialised field and the demand for professionals in this field is a derived demand based on the expansion of ocean related activities. Since the contribution of ocean economy is projected to double by 2030, the demand for these services is bound increase and most of these services are Information and Communication Technology (ICT) supported and are 'gender friendly'.

It is important and critical to develop 'blue jobs' for all in general and women in particular and to create a platform to develop the required skills and reduce the skill gaps. In order to achieve this, there is an urgent need for developing new maritime education centres and at the same time increasing the capacity of existing centres.

The Blue Economy and African women: recent initiatives

With the developments in the Blue Economy, many regional efforts have taken the initiative to increase women's employment opportunities in the marine sector. These include the First Continental Conference on the Empowerment of African Women in Maritime (CCEAWM) in Luanda, Angola, in March 2015, which led to the emergence of a common agenda or platform of action for maritime women in Africa and evolved the basis for creating appropriate institutional frameworks on the continent to operationalise this agenda. The main objective is to strengthen training and development (technical and soft skills) programmes so as to ensure that the current skills gap faced within the Blue Economy industry is reduced continentally. Technical Vocational Education and Training (TVET) centres across Africa are being developed to match labour demand and supply and increase employability rates. The goal is to close the skills gap and to ensure that women and the youth are provided with the adequate knowledge and skills to be entrepreneurs.

According to Dr Nkosazana Dlamini-Zuma, former chairwoman of the 54-member African Union (AU), the African continent should adopt a two-pronged strategy for optimum utilisation of natural resources and rapid industrialisation: women and oceans. And the trick lies in synergising the two. The Blue Economy is a vital part of the industrialisation plan of Africa (Agenda 2063) and it can also be used to promote employment and leadership of women. In her own words,

Now we're trying to get everybody to focus on this and we are also saying to women that this is an underdeveloped area. Don't let the men develop it. Don't come in at the end. You must be part of that development.

In 2016, the Association of African Maritime Administrations (AAMA) and the Association of Women in the Maritime Sector in Eastern and Southern Africa (WOMESA) signed a memorandum of understanding to strengthen the role and impact of women's participation in the continent's maritime economic sector development.⁴²

Today, the maritime sector has become a viable and critical option for addressing rising unemployment on the African continent. According to the South African Maritime Professionals Association (SAMPA), it provides vast career opportunities with an indication that at least one million jobs can be created. This sector is a robust national asset which has also created a platform for young entrepreneurs to pursue business interests.⁴³ Further, increased female representation is required to deal with gender imbalances in the sector. As Mbongi Qwabe, president of the South African Maritime Professionals Association (SAMPA) has stated,

We need more women in the maritime sector in order to transform the industry and take it forward. In the past, the sector was a no-go area for women because of its associated danger. But now more women are getting involved.⁴⁴

Qwabe pointed out that specific efforts are required in the maritime sector for women to build networks, inspire and support mutually and grow in number and importance. While recognising efforts being made to include more women the maritime sector at the recent South African Maritime Industry Conference (SAMIC) 2017, delegates were scathing in their assessment of the position and participation of women overall in the African maritime sector. They argued that the industry was still the preserve of white men who held senior positions. But the female delegates across Africa, from Nigeria to Maputo to South Africa, acknowledged that the responsibility also lay with women to entrench and assert themselves as deserving role-players.

Some of the transformation efforts in boosting women in the maritime field in Africa are noteworthy:⁴⁵

- Lulama Mthembu was appointed as the first black female marine pilot in the Port of Saldanha in 2009 at the age of 27.
- Pinky Zungu, Precious Dube, and Bongiwe Mbambo were the first three women in Africa to obtain a marine pilot open licence in 2011: they can now navigate vessels of any size and type in South African waters.

- Londy Ngcobo became Africa's first female dredge master in 2014.
- Pinky Zungu was appointed as the first female deputy harbour master: nautical in the port of Durban in 2016.
- Nandipha Mtsokoba, presently employed as a senior engineer in the Port of Durban, is managing a team of eight female engineering project managers to help deliver a world class Durban ship-repair precinct by the end of 2019.
- In 2016, Captains Tshepo Motloutsi, Thembela Taboshe, and Pretty Molefe were appointed as the first black female master mariners or ship captains.
- Four marine industry women have been selected among 130 recipients to receive the Women in Manufacturing STEP (Science, Technology, Engineering and Production) Ahead Award from the Manufacturing Institute for 2016. The STEP Ahead Awards honour women who show excellence and leadership qualities in their careers and represent all levels of the manufacturing industry.

The South African Maritime Safety Authority (SAMSA) has stated that the appointment of women, as well as young people, responded positively to a critical shortage of female master mariners or ship captains not only in South Africa, but also worldwide. SAMSA's own cadet training program for seafarers encourages the participation of women. The International Transport Workers' Federation is of the opinion that a radical plan of action is required globally to deal with the gender imbalance in the sector. In a statement, the federation called on employers, the International Labour Organisation and trade unions to prioritise issues that have been identified as vitally important for women seafarers.⁴⁶

IORA and women

The Indian Ocean Rim is a region comprising of the states whose shores are washed by the waters of the Indian Ocean. Home to about two billion people, it is a region of great cultural diversity and richness – in languages, religions, traditions, arts and cuisines.

The countries of the region vary considerably in terms of size, population and level of economic development. They may also be divided into a number of sub-regions (Australasia, Southeast Asia, South Asia, West Asia, and Eastern and Southern Africa), each with their own regional groupings (such as ASEAN, SAARC, GCC, and SADC, to name a few). The GDP per capita (PPP) of these countries varies between a low of US\$1 500 and a high of US\$79 000 with 31 per cent (Oman) to 86 per cent (Seychelles) of it coming from the services sector.

Nevertheless, these countries are bound together by the Indian Ocean. Building on common historical and geopolitical experiences of the states of the region, the

Indian Ocean Rim Association (IORA) was created in 1997. Today it comprises 21 member states and eight dialogue partners. IORA has identified six priority sectors: maritime safety and security, trade and investment facilitation, fisheries management, disaster risk management, academic, science and technology, and tourism and cultural exchanges 'with strong focus on Blue Economy and women's economic empowerment' as cross cutting themes.

Many initiatives to promote sustainable development of the Blue Economy have indeed been taken by IORA in the recent past, but when it comes to gender empowerment the efforts have been rather lukewarm. In a meeting of Council of Ministers in 2013, women's empowerment was identified by IORA as an important cross-cutting issue. The Policy Approach stated,

IORA may consider the development of a framework for integrating gender perspectives in its programmes and activities and supporting gender analysis and equality in view of scaling up its efforts to close gender gaps, enhance economic growth, and strengthen the sustainability of development initiatives undertaken within the region....⁴⁷

Conferences and symposia related to different dimensions of women empowerment have been organised by IORA in the recent past. Both the Mauritius Declaration (Sept 2015) and the Jakarta Declaration on Blue Economy (May 2017) include women empowerment as an accepted cross-cutting principle. An important initiative of IORA was the organisation of a two-day conference focusing on 'Mobilising Markets and Commitments to Gender Equality in the Indian Ocean', in the Seychelles in 2015. The discussions at the conference revolved around a study initiated by IORA in 2014 to analyse women's participation in economic development in its member countries, either as employees or as entrepreneurs. The major recommendations of this conference led to the adoption of the 'Mahé Consensus on Gender Equality and Women's Economic Empowerment'. It reiterates IORA's commitment to advance gender equality and women's economic empowerment in the Indian Ocean Rim region stating,

We recognize the critical role that women play in achieving economic prosperity in IORA Member States and in the region as a whole, and that excluding or limiting women's participation in the workforce results in a heavy loss to the overall productivity of these economies. Higher female earnings and autonomy lead to greater investment in children's health and education, which results in longer term economic growth. Further, the realisation of economic empowerment is important to women themselves.⁴⁸

However, despite strong intentions and the right direction, IORA has not been able to draw a long-term action plan to operationalise women empowerment initiatives in the Blue Economy. The declarations are too general in nature to make any significant dent on gender inequality in the region. Building on the Mahé Declaration, IORA needs to take more concrete steps, systematically generating gender statistics for member states, and inject a focus on gender perspective and women empowerment into all policies and programmes related to Blue Economy.

Progress in the region has accelerated since 2013 with the IORA Declaration on Gender Equality and Women's Economic Empowerment adopted at the 16th Council of Ministers Meeting held in 2016 in Bali, Indonesia.⁴⁹ This declaration upholds important principles that recognise women's empowerment as being essential to the economic and social prosperity of the peoples living in the IOR. Member States pledged to promote women's rights by affirming that:

- Women's economic empowerment is a foundational element of gender equality and the full and equal realisation of women's human rights.
- Women's full and equal participation and leadership in the economy are vital for realising gender equality and empowerment of women that will make a crucial contribution to progress across all goals and targets of the 2030 Agenda.
- Higher female earnings also lead to greater investment in children's health and education, which likewise contribute to longer term economic growth.
- Many women in IORA Member States are engaged in the informal economy, without adequate job or income security and inadequate social protection.
- Women make a significant contribution to peace and security, which are key ingredients for advancing economic prosperity.
- Women's voice, participation in leadership and decision-making is important in our quest for gender equality and women's economic empowerment and sustainable economic growth.

The Jakarta Concord *Promoting Regional Cooperation for a Peaceful, Stable and Prosperous Indian Ocean*, was a key outcome of the Leaders' Summit in 2017 and continued to reflect the commitment of the IORA Members States to the principles of gender equality and empowerment.⁵⁰

The road ahead

The Blue Economy paradigm offers an innovative approach to conserving the oceans, while reaping their benefits in a more equitable and sustainable way. Countries across the globe are increasingly recognising the potential of Blue Economy

for future economic growth. However, this growth will not be sustainable and inclusive until and unless it increases gender parity. Moreover, gender parity in itself is growth promoting because it increases economic productivity, improves development outcomes for the next generation, and makes policies and institutions more representative. Therefore, the expansion of a Blue Economy should be accompanied by a larger, more varied, and efficient participation of women.

This can be achieved only if gender perspective is integrated, both theoretically and operationally, into the Blue Economy paradigm at the outset. However, gender statistics are almost non-existent in most of the Indian Ocean Rim states, which makes status assessment and policy formulation all the more difficult. Therefore, there must be systematic integration of gender in national statistics. This will help in identifying the potential of and challenges to gender parity and help in building a national, regional and international policy consensus.

Capacity building and favourable socio-cultural changes are also imperative to reduction in gender-inequality in future. Ample opportunities must be given to women for technology supported training and skill formation to enable them to move from low value addition activities to high value addition activities. Acknowledging and sharing of local success stories of women workers and entrepreneurs on a wider platform will help in creating a more conducive social environment. It may motivate many women to take the less trodden path and enter hitherto male dominated ocean-related activities. Needless to say, the state and international development institutions have a crucial role to play in designing and implementing appropriate micro- and macro-level strategies for ensuring gender parity in the future growth of the Blue Economy.

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SECTION II

Indian Ocean Governance and Policy Frame

Convention on the Law of the Sea and Blue Economy

Siqhamo Yamkela Ntola

Introduction

The 1982 United Nations (UN) Convention on the Law of the Sea (LOSC)¹ is the international instrument that delineates the law in respect of the sea. The LOSC is the ‘constitution for the oceans’,² the adoption of which was ‘prompted by the desire to settle, in a spirit of mutual understanding and cooperation, all issues relating to the law of the sea’.³ It recognises the desire to establish a legal order ‘which will facilitate international communication, and will promote the peaceful uses of the seas and oceans, the equitable and efficient utilisation of their resources, the conservation of their living resources and the study, protection and preservation of the marine environment’.⁴ As such, the LOSC outlines the rights and duties of states in undertaking activities relating to navigation,⁵ exploring, and exploiting living and non-living resources,⁶ protecting and preserving the marine environment⁷ as well as marine scientific research.⁸ It also provides the means for achieving legal certainty with regard to delimiting overlapping maritime zones.⁹

The Convention captures the ambitions of those state parties that contributed toward its adoption and coming into effect, particularly developing states, which sort to gain further access to ocean spaces in order to assume exclusive access to the resources therein.¹⁰ Such access was deemed crucial for economic and socio-economic development.¹¹ Indeed, some member states of the Indian Ocean Rim Association (IORA) were among those that contributed toward the coming into effect of the LOSC in 1994, with seven¹² among the 60 ratifications required to bring the convention into effect.¹³ Following the sixtieth ratification, consistent with the pace of ratifications at the time, 11 of the 21 IORA member states ratified the LOSC,¹⁴ with only one member state ratifying in the last decade.¹⁵ In total, a majority of 19 of the 21 IORA member states have ratified the LOSC,¹⁶ thus indicating

their active role in putting into place the necessary governance infrastructure for developing an ocean economy.

Since coming into effect, a great number of coastal states have claimed the maritime zones provided for in the convention,¹⁷ thus ensuring the exclusive access so fervently advocated from the First to the Third United Nations Conference on the Law of the Sea (UNCLOS I-III).¹⁸ It is predominantly within these maritime zones that IORA seeks to cooperate in developing a 'Blue Economy' for the benefit of its member states and the region of the Indian Ocean Rim.¹⁹

Accordingly, it is within the ambit of the LOSC that the IORA must develop a Blue Economy. This includes adhering to the 1994 and 1995 Agreements, which are: the Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea ('the 1994 Agreement');²⁰ and the United Nations Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks ('the 1995 Agreement').²¹ These agreements qualify the LOSC's provisions with regard to exploitation activities in the seabed beyond national jurisdiction, as well as the exploitation of straddling and highly migratory fish stocks within and beyond national jurisdiction, thus further informing the ambit within which IORA member states are to develop the Blue Economy in the aforementioned respects.

To that end, this chapter will discuss those provisions of the LOSC that speak to the development of a Blue Economy. These provisions pertain to navigation, the exploitation of marine resources within and beyond national jurisdiction, the protection and preservation of the marine environment and marine scientific research. The chapter sheds light on how those provisions that significantly influence the work of IORA apply to it and its member states.

LOSC framework

Jurisdictional certainty

Maritime zones within national jurisdiction

As indicated above, the LOSC provides for the legal zones within which a coastal state may exercise its jurisdiction. For instance, the territorial sea is the adjacent belt of sea extending from a coastal state's land territory.²² A coastal state's territorial sea may not extend farther than 12 nautical miles (nm) from the baseline determined in accordance with the convention.²³ With this extension, the sovereignty

of a coastal state is not only limited to the waters of the territorial sea, but also to the air space over it, as well as the seabed and subsoil.²⁴

Further, a coastal state may extend its jurisdiction to include the exclusive economic zone (EEZ),²⁵ a legal zone that may be claimed to a maximum breadth of 200 nm from the baseline used to measure the territorial sea.²⁶ Like the territorial sea, a coastal state's jurisdiction is not limited to the waters of the EEZ, but extends to the seabed and subsoil of the continental shelf, the presence of which is not dependant on 'occupation, effective or notional, or any express proclamation'.²⁷ Jurisdiction over the latter zone may extend beyond 200 nm when recommendations to that effect have been made by the Commission on the Limits of the Continental Shelf (CLCS).²⁸

It is within these zones that a coastal state has exclusive rights to explore and exploit its living and non-living resources, and to undertake other economic activities such as 'energy production from the water, currents and winds', as well as protect and preserve the marine environment.²⁹ However, considering the geographic configuration along the coasts of some states, and the proximity of neighbouring states with opposite coasts, claims by a coastal state to the above zones may overlap with those of neighbouring states. In these circumstances, the extent of a coastal state's jurisdiction over its ocean space is unclear.³⁰ The LOSC does provide for the methods for achieving legal certainty where the territorial seas,³¹ EEZs³² and the continental shelf³³ of neighbouring coastal states overlap.³⁴ In this respect, the Convention provides for delimitation through agreement or through third party proceedings (provided for in Part XV), should negotiations for an agreement be unsuccessful. Pending an agreement, the states concerned can enter into provisional arrangements of a practical nature that will 'not jeopardise or hamper the reaching of a final agreement'.³⁵ Concerning IORA member states, un-delimited maritime boundaries may hamper cooperation initiatives pertaining to developing a Blue Economy, as there is no jurisdictional certainty over the ocean spaces where such initiatives will occur.

Indeed, IORA member states that have delimited their overlapping waters in the Indian Ocean Rim in accordance with the LOSC are: Australia/Indonesia, Bangladesh/Myanmar, India/Indonesia, India/the Maldives, India/Myanmar, India/Sri Lanka, India/Thailand, India/Indonesia/Thailand, India/the Maldives/Sri Lanka, India/Myanmar/Thailand, Indonesia/Malaysia, Indonesia/Singapore, Indonesia/Thailand, Indonesia/Malaysia/Thailand, Iran/United Arab Emirates, Iran/Oman, Kenya/Tanzania, Madagascar/France (with regard to Reunion Island), Malaysia/Singapore, Malaysia/Thailand, Mauritius/France (with regard to Reunion Island), Mauritius/the Seychelles, Mozambique/Tanzania, Myanmar/Thailand, Oman/Yemen, Oman/Pakistan, the Seychelles/France (with regard to Glorioso Islands), and the Seychelles/Tanzania.³⁶

The un-delimited maritime zones in the Indian Ocean Rim that involve IORA member states are between: the Comoros/Madagascar, the Comoros/Mozambique, the Comoros/the Seychelles, the Comoros/Tanzania, India/Pakistan, Indonesia/Timor-Leste, Iran/Pakistan, Madagascar/France, Madagascar/Mozambique, Madagascar/the Seychelles, Madagascar/South Africa, Mozambique/South Africa, Somalia/Kenya, Somalia/Tanzania and Somalia/Yemen.³⁷

Where ocean spaces are un-delimited, IORA member states should aim at entering into provisional arrangements of a practical nature, such as in the case of Mauritius and the Seychelles over the Mascarene Plateau region.³⁸ This will ensure that the disputing states jointly benefit from exploiting the resources in the disputed area, and that they jointly undertake to protect the marine environment. Such provisional arrangements may also go as far as providing for the sharing of marine scientific research undertaken in the area. Engaging in such arrangements may have the effect of strengthening already existing bonds or reducing tension among IORA member states.

Maritime zones beyond national jurisdiction

Beyond areas of national jurisdiction is the 'Area' and the high seas. As alluded to above: the former is the seabed and subsoil; the latter is formed by the waters superjacent to the Area and extending from the outer limits of national jurisdiction.³⁹

In the Area, the mineral resources therein are the 'common heritage of mankind',⁴⁰ meaning that they vest in humankind as a whole. Therefore, 'no such claim or exercise of sovereignty or sovereign rights nor such appropriation shall be recognised'.⁴¹ The International Seabed Authority (ISA) is the organisation established by the LOSC⁴² through which state parties to the LOSC must organise and control activities in the Area, with the particular view of administering the resources.⁴³

Similar to the Area, the waters of the high seas are not subject to the sovereignty of any state.⁴⁴ Accordingly, the high seas are open to all states, coastal and landlocked, and may be used 'under the conditions laid down by [the LOSC] and by other rules of international law'.⁴⁵ The freedoms enjoyed by states on the high seas include: freedom of navigation,⁴⁶ freedom of overflight, freedom to lay submarine cables and pipelines,⁴⁷ freedom to construct artificial islands and installations, freedom of fishing and freedom of scientific research.⁴⁸ These freedoms are not without limitations, for instance, states must have 'due regard for the interests of other states in their exercise of the freedom of the high seas',⁴⁹ as well as due regard for the rights under the LOSC for activities in the Area.⁵⁰

Navigation

Navigation is among the oldest uses of the sea, and considering that over 90 per cent of world trade is carried by sea,⁵¹ it is, in an economic context, among the most important uses of the sea.

Within national jurisdiction, in a coastal state's internal waters, a foreign ship does not have the general right of entry, except in the case of distress, and where waters become international waters owing to the establishment of straight base-lines.⁵² In these waters, foreign ships have the same right of innocent passage as they have in the territorial sea, meaning that 'ships of all states, whether coastal or land-locked, enjoy the right of innocent passage'.⁵³

The LOSC defines 'passage' as 'navigation through the territorial sea for the purpose of: (a) traversing that sea without entering internal waters or calling at a roadstead or port facility outside internal waters; or (b) proceeding to or from internal waters or a call at such roadstead or port facility'.⁵⁴ 'Passage is innocent so long as it is not prejudicial to the peace, good order or security of the coastal state'.⁵⁵ For example, a vessel carrying inventory for trade purposes may pass through the territorial sea of a coastal state, provided that its passage does not threaten the security of the said coastal state. With this in mind, and considering issues concerning maritime security in the region, the navies of the IORA member states may seek to cooperate to ensure security for trade and tourism purposes.

Beyond the territorial sea, all ships enjoy, in principle, freedom of navigation under the 'flag state's' exclusive jurisdiction. The freedom is, however, subject to limitations. For instance, in the contiguous zone, which a coastal state may establish to a maximum breadth of 24 nm from the baseline used to determine the outer limits of the territorial sea,⁵⁶ a coastal state may exercise controls necessary to prevent and punish infringement of its customs, immigration and sanitary laws.⁵⁷ In the EEZ, the freedom of navigation is subject to a coastal state's laws relating to resource use.⁵⁸

Further, in the EEZ and the waters above the continental shelf, the freedom of navigation is subject to the obligation to respect safety zones around artificial islands and installations.⁵⁹ However, a coastal state is obligated to not erect artificial islands and installations that may cause interference with the use of recognised sea-lanes that are essential to international navigation.⁶⁰ On the high seas, the freedom of navigation is subject to the general obligation to have 'due regard' to the interests of others in their exercise of the freedom.⁶¹

Exploitation of marine resources

Living resources within national jurisdiction

Next to navigation, fishing is the oldest use of the sea. Within areas of national jurisdiction such as internal waters and the territorial sea, coastal states have exclusive access to the fish stocks in those waters, particularly considering that the right of innocent passage is the only right afforded to states other than the coastal state.⁶² Sovereignty over living resources also extends to the EEZ where the coastal state must, for conservation purposes, determine the allowable catch.⁶³ In instances where fish stocks occur within the EEZs of two or more states (shared stocks), the states must, through regional or sub-regional organisations, agree upon measures necessary to ensure the development and conservation of such stock.⁶⁴ The Indian Ocean Tuna Commission and the Commission for the Conservation of Southern Bluefin Tuna are the regional fisheries organisations that IORA member states can participate in with regard to the species of fish that inform the core business of the organisations. The IORA may co-operate with the aforementioned organisations for other fish species within as well as beyond national jurisdiction, as has been done before.⁶⁵

Living resources beyond national jurisdiction

As indicated earlier, the 1995 Agreement pertains to straddling and highly migratory fish stocks within and beyond areas of national jurisdiction.⁶⁶

In terms of the agreement, state parties are to conserve and manage straddling fish and highly migratory fish stocks by giving effect to their duty to co-operate in accordance with the LOSC with regard to, *inter alia*: adopting measures that will ensure their long-term sustainability and promote their optimum utilisation; applying the precautionary principle; and taking 'measures to prevent or eliminate overfishing and excess fishing capacity and to ensure that levels of fishing effort do not exceed those commensurate with the sustainable use of fishery resources'.⁶⁷ The agreement further provides for co-operation for conservation and management of straddling and highly migratory fish stocks, management at a regional and sub-regional level, as well as the duties of flag states that fish in the high seas.⁶⁸

Non-living resources within national jurisdiction

Similar to exploiting living resources, the seabed and subsoil in the internal and territorial waters of a coastal state forms part of its territory. As such, the state has

exclusive access to the non-living resources therein.⁶⁹ The same applies to the EEZ and continental shelf.

The non-living resources referred to above consist of mineral and other non-living resources of the seabed and subsoil, together with living organisms belonging to sedentary species; that is to say, organisms 'at the harvestable stage, either are immobile on or under the seabed or are unable to move except in constant physical contact with the seabed or the subsoil'.⁷⁰ A coastal state's exclusivity with regard to the resources on its seabed and subsoil entails that no one may undertake exploitation activities without the express consent of the coastal state.⁷¹

Where the continental shelf of a coastal state extends beyond 200 nm, and has been established by the coastal state following recommendations to that effect by the CLCS,⁷² the rights of the coastal state are subject to some limitations. This is because the adjacent seabed is the Area, the resources of which are the common heritage of mankind. Article 82 of the LOSC provides for the abovementioned limitations.

In terms of article 82(1), coastal states that have established an extended continental shelf and are undertaking exploitation activities in the region are to 'make payments and contributions in kind in respect of the exploitation of the non-living resources'.⁷³ These payments and contributions are 'to be made annually in respect of all production at a site after the first five years of production at that site', and that the rate shall increase by per cent for each following year until the twelfth year and remain at 7 per cent thereafter.⁷⁴ Developing states are exempt from making the above payments and contributions, if they are net importers of the mineral resources produced.⁷⁵

IORA member states that have claimed the various zones provided for in the LOSC have exclusive access to the resources therein. As indicated above, and as far as non-living resources are concerned, IORA member states should aim to make provisional arrangements of a practical nature where there are disputes over ocean space, so as to ensure mutual benefit from exploitation activities conducted. This is especially important when considering that resources such as oil and gas may straddle these areas. Further, those IORA member states that have claimed an extended continental shelf will need to consider how best to implement article 82 of the LOSC.

Non-living resources beyond national jurisdiction

In the Area, the exploitation of 'solid, liquid or gaseous mineral resources ... beneath the seabed, including polymetallic nodules'⁷⁶ is subject to the provisions of Part XI of the LOSC. This part 'provides for a parallel system in the sense that those resources may be exploited by the Enterprise⁷⁷ and other operators'.⁷⁸

In order to prospect, the ISA has to be notified ‘of the approximate area or areas in which prospecting is to be conducted’ and provided with ‘a satisfactory written undertaking that the proposed prospector will comply with [the LOSC] and the relevant rules, regulations and procedures of the [ISA]’.⁷⁹ In contrast, operators wishing to explore and exploit resources in the Area must submit an application that ‘must cover a total area, which need not be a single continuous area, sufficiently large and of sufficient estimated commercial value to allow two mining operations’. The other site is for the enterprise.⁸⁰

Concerning financial benefits associated with exploitation in the Area, the ISA is directed to ensure ‘the equitable sharing of financial and other economic benefits derived from activities in the Area through any appropriate mechanism, on a non-discriminatory basis’.⁸¹ However, the LOSC requires that the ISA, through the Assembly⁸² establish:

a system of compensation or take other measures of economic adjustment assistance including cooperation with specialised agencies and other international organisations to assist developing countries which suffer serious adverse effects on their export earnings or economies resulting from a reduction in the price of an affected mineral or in the volume of exports of that mineral, to the extent that such reduction is caused by activities in the Area.⁸³

Indeed, developing IORA member states will be among those to benefit from exploitation activities in the Area as well as from the above-mentioned compensation or economic adjustment for activities in the Indian Ocean Rim. The IORA may cooperate with the ISA in devising such a system.

Protecting the marine environment

Economic activities, particularly those mentioned in the above two sub-sections, pose a threat to the marine environment. In terms of Goal 14 of the United Nations Sustainable Development Goals (SDGs),⁸⁴ the international community of states aims to ‘conserve and sustainably use oceans, seas and marine resources’ by the year 2030. The targets set in respect of achieving this goal include: preventing and significantly reducing all kinds of marine pollution, particularly pollution from land-based activities, including marine debris and nutrient pollution by 2025;⁸⁵ and conserving at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific research.⁸⁶ As far as international law is concerned, state parties to the LOSC are compelled to protect and preserve the marine environment,⁸⁷ especially considering their sovereign right to exploit the natural resources in their ocean spaces.⁸⁸ The term

‘marine environment’ is not defined in the LOSC, thus allowing the ‘Convention an element of flexibility in accommodating the continuously-expanding human knowledge and human activities relating to the marine environment, including its protection and preservation’. However, ‘pollution of the marine environment’ means:

the introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities.⁸⁹

It is important to note that:

[a]s this definition suggests, it is not the aim of international law to prevent all substances being added to the sea – many substances are harmless or are rapidly rendered so by the sea – but only those which have or are likely to have deleterious effects. For this reason, the definition has sometimes been criticised for not taking sufficient account of the need to prevent changes in the marine environment as such, and apart from any immediately identifiable possible deleterious effects.⁹⁰

The LOSC directs coastal states to take all measures, individually or jointly, consistent with it ‘to prevent, reduce and control pollution of the marine environment from any source’. The sources of pollution identified in the LOSC include pollution from land-based sources, pollution from seabed activities subject to national jurisdiction, pollution from activities in the Area, pollution by dumping, pollution from vessels, and pollution from or through the atmosphere.⁹¹

Also, the LOSC compels state parties to cooperate on a global basis, and as appropriate, on a regional basis ‘directly or through competent international organisations, in formulating and elaborating international rules, standards and recommended practices and procedures consistent with [it]’ for protecting and preserving the marine environment.⁹² Areas of cooperation identified by the LOSC include:⁹³ notifying other states of imminent or actual damage by pollution; developing contingency plans for responding to pollution incidents; undertaking scientific research and exchanging information and data acquired about pollution and in this regard, establishing the appropriate scientific criteria for the formulation and elaboration of rules, standards, and recommended practices and procedures for preventing, reducing and controlling pollution in the marine environment.⁹⁴ It is clear, as far as environmental protection is concerned, that the formation of IORA is in accordance with the LOSC, when considering that among the IORA’s

objectives is the formulation and implementation of projects for economic cooperation relating to, *inter alia*, the protection of the environment.

The IORA may co-operate with the relevant programmes under the United Nations Development Programme – Regional Seas Programme (RSP). The RSP is the ‘most globally comprehensive initiative for the protection of marine and coastal environments’.⁹⁵ It covers 18 regions around the world, with most programmes having adopted legally binding framework conventions that provide for the adoption of protocols for the various sources of marine pollution. Considering the uniformity of the conventions throughout the different regions and the participation of some IORA member states within the RSP frameworks, cooperation between the organisations will, in turn, ensure uniformity with regard to the legal obligations undertaken by those IORA member states that are party to RSP conventions. The fruits of such co-operation include, among other things, encouraging participation by those IORA member states that are not party to RSP conventions, and effective utilisation by IORA of existing legal frameworks that are aligned with both the LOSC and its principles and objectives.

Marine scientific research

The phrase ‘marine scientific research’

refers to a variety of scientific disciplines, such as biology, biotechnology, geology, chemistry, physics, geophysics, hydrography, physical oceanography, and ocean drilling and coring, which are dedicated to the study of ocean, marine flora, fauna and physical boundaries with the solid earth and the atmosphere. The purpose of such research is to ‘observe, to explain, and eventually to understand sufficiently well how to predict and explain changes in the natural (marine) world’.⁹⁶

Accordingly, marine scientific research serves as a precondition for rational exploitation of the sea’s resources, the preservation of the marine environment, safer navigation, and military uses of the sea.⁹⁷

No different to the abovementioned activities, the rights of a coastal state with regard to marine scientific research, vary on the basis of where those activities are undertaken. In the territorial sea, the coastal state has the exclusive right to regulate, authorise and conduct marine scientific research. This means that research may only be conducted with the consent,⁹⁸ and subject to the conditions set forth by the coastal state.⁹⁹ The same principle applies to the internal waters of a coastal state or the archipelagic waters of an archipelagic state.¹⁰⁰ In instances where the territorial sea forms part of a strait used for international navigation or an archipelagic sea lane, the LOSC provides that ‘foreign ships, including marine

scientific research and hydrographic survey ships, may not carry out any research or survey activities without the prior consent of the states bordering the straits' or archipelagic sea lane.¹⁰¹

In the EEZ and continental shelf, a coastal state also has the right to regulate, authorise and conduct marine scientific research.¹⁰² As such, the consent of the coastal state is required for such activities to commence.¹⁰³ In normal circumstances, coastal states must 'grant their consent for marine scientific research projects by other states or competent international organisations in their [EEZ] or on their continental shelf to be carried out in accordance with [the LOSC] exclusively for peaceful purposes and in order to increase scientific knowledge of the marine environment for the benefit of mankind'.¹⁰⁴ 'Normal circumstances may exist in spite of the absence of diplomatic relations between the coastal state and the researching state'.¹⁰⁵ The implication is, therefore, that 'circumstances are "normal" except where there is hostility or serious tension between the coastal state and the researching state', such as armed conflict.¹⁰⁶ A delimitation dispute over the area where marine scientific research is proposed may serve as an abnormal circumstance, although it is less obvious. In instances of 'abnormality', as it relates to consenting to marine scientific research, the coastal state bears the burden of proof to withhold its consent.¹⁰⁷ The coastal state may also give its consent 'if that project:

- (a) is of direct significance for the exploration and exploitation of natural resources, whether living or non-living;
- (b) involves drilling into the continental shelf, the use of explosives or the introduction of harmful substances into the marine environment;
- (c) involves the construction, operation or use of artificial islands, installations and structures ...;
- (d) contains information communicated pursuant to article 248 regarding the nature and objectives of the project which is accurate or if the researching state or competent international organisation has outstanding obligations to the coastal state from a prior research project'.¹⁰⁸

As mentioned earlier,¹⁰⁹ marine scientific research is among the freedoms afforded states on the high seas.¹¹⁰ In the Area, states are permitted to conduct research, provided that it conforms with Part XI of the LOSC.¹¹¹ This means that the research must be conducted for peaceful purposes and for the benefit of mankind as a whole.¹¹² The LOSC compels the ISA to promote and encourage marine scientific research in the Area and to distribute 'results of such research and analysis when available'.¹¹³

As far as research conducted within national jurisdictions is concerned, the co-operative spirit underlying the IORA lends itself to developing partnerships with

regard to sharing scientific research that will assist in sustainably exploiting the marine environment. For instance, under the auspices of the IORA, member states may, through a memorandum of understanding (MoU), allow marine scientific research to be conducted within their ocean space by other IORA member states. The MoU will meet the requirements of the LOSC with regard to consent. Such undertaking may be on condition that the research must be shared through IORA. With regard to disputed ocean space, as indicated above, the provisional arrangement of a practical nature will have the effect of normalising what may be considered abnormal circumstances for conducting marine scientific research in those areas.

Conclusion

The above discussion of the LOSC's provisions highlights the international framework within which a Blue Economy must develop in the Indian Ocean Rim, especially considering the extent of ratifications of the instrument. Driving such developments is the need for resources such as food and energy for the world's growing population. Indeed, advancements in marine scientific research are critical for accessing ocean resources; however, goal 14 of the SDGs demonstrates that leaders of the international community of states are cognisant of the adverse effects of existing development practices on the world's oceans. The development of a Blue Economy, as advocated by IORA member states, demonstrates the desire to advance their individual and collective economies within ecological parameters. The LOSC is among the international instruments that align with this vision. Indeed, IORA may develop its regional architecture pursuant to the co-operation provisions of the LOSC with regard to marine pollution as well as co-operation in areas essential for Blue Economy development in terms of the rules of international law that are consistent with the LOSC.

Notes and References

- 1 1833 *UNTS* 3, (1982) 21 *ILM* 1245.
- 2 See speech by Koh, T.B. titled, 'A Constitution for the Oceans', at the UN. 'A Constitution for the Oceans' Remarks by Tommy T.B. Koh, of Singapore, President of the Third United Nations Conference on the Law of the Sea. Available at: http://www.un.org/depts/los/convention_agreements/texts/koh_english.pdf [Accessed 26 November 2016].
- 3 Paragraph 1, LOSC Preamble.
- 4 Paragraph 4, LOSC Preamble.
- 5 See for instance Part III, section 2 and 3 of LOSC.

- 6 Art. 56(1)(a) and 77(1) LOSC.
- 7 Part XII of LOSC.
- 8 Part XIII of LOSC.
- 9 See 'Jurisdictional certainty' below.
- 10 Akintoba, T., 1996. African States and contemporary international law: A case study of the 1982 Law of the Sea Convention and the exclusive economic zone. Leiden: Martinus Nijhoff, pp.75-87; Mlimuka, A., 1998. The eastern African states and the exclusive economic zone: A case of EEZ proclamations, maritime boundaries and fisheries. London: Transaction Publishers, Chapter 3; Tsamenyi, M. and Ali, K., 2012. African states and the Law of the Sea Convention: Have the benefits been realized? *Ocean Yearbook*, 26, pp.120-121; Thompson, M., 1980. The third world and the Law of the Sea: The attitude of the Group of 77 toward the continental shelf. *Boston College Third World Law Journal*, 1(1), pp.41-58.
- 11 Boczek, B., 1984. Ideology and the law of the sea: The challenge of the new international economic order. *Boston College International and Comparative Law Review*, 7(1), pp.12-13.
- 12 These states are: Kenya (1989), Indonesia (1986), the Seychelles (1991), Somalia (1989), Oman (1989), Tanzania (1985) and Yemen (1987).
- 13 The LOSC came into effect one year following the 60th ratification by Guyana on 16 November 1993. Yugoslavia was the twenty-ninth state to ratify, but subsequently ceased to exist.
- 14 These states are: Australia (1994), Bangladesh (2001), the Comoros (1994), India (1995), Madagascar (2001), Malaysia (1996), Mauritius (1994), Mozambique (1997), Singapore (1994), South Africa (1997) and Sri Lanka (1994).
- 15 UN, 2011. Chronological list of ratifications of, accessions and successions to the Convention and the related agreements. Available at: http://www.un.org/depts/los/reference_files/chronological_lists_of_ratifications.htm#The%20United%20Nations%20Convention%20on%20the%20Law%20of%20the%20Sea [Accessed 18 January 2017].
- 16 Iran and the United Arab Emirates have not ratified the LOSC.
- 17 See 'Jurisdictional certainty' below.
- 18 UNCLOS I was held from 24 February to 27 April 1958 and was convened by UN General Assembly Resolution 1105(XI) of 21 February 1957. UNCLOS II was held from 17 March to 26 April 1960, following a request by the UN General Assembly to the Secretary-General (Resolution 1307[XIII]) to convene a second conference to consider the breadth of the territorial sea, which had not been agreed upon in the 1958 Conventions. UNCLOS III was convened in 1974, pursuant to UN General Assembly Resolution 2750 C (XXV) of 17 December 1970. The Law of the Sea regime, as a whole, was negotiated at the conference. See Tsamenyi and Ali, 2012, pp.113, 116 and 119. For background on UNCLOS I-III, see Miller, H., 1930. The Hague Codification

Conference. *The American Journal of International Law*, 24, pp.674-686; Nandan, S.N. and Lodge, W.A., 2002. The development of the regime for deep seabed mining. The International Seabed Authority, p.5; Brown, E.D., 1994. *The International Law of the Sea*, vol 1. Dartmouth: Bookfield, p.5; Rembe, N.S., 1980. *The international law of the sea: A study of the contribution of the African states to the Third United Nations Conference on the Law of the Sea*. Germantown: Sijthoff.

- 19 IORA. Blue Economy. Available at: www.iora.net/blue-economy/blue-economy.aspx [Accessed 3 January 2017].
- 20 2167 UNTS 88; (1995) 34 *ILM* 1542.
- 21 Also known as the 1995 UN Fish Stocks Agreement (1836 UNTS 3).
- 22 Art. 2(1) of LOSC.
- 23 Art. 3 of LOSC.
- 24 Art .2 of LOSC.
- 25 Art. 57 of LOSC.
- 26 Practically, if a maximum breadth of the territorial sea is claimed, the EEZ may not extend beyond 188 nm from the outer limits of the territorial sea.
- 27 The continental shelf 'comprises the seabed and subsoil of the submarine areas that extend beyond its territorial sea throughout the natural prolongation of its land territory to the outer edge of the continental margin, or to a distance of 200 nautical miles from the baselines from which the breadth of the territorial sea is measured where the outer edge of the continental margin does not extend up to that distance'. As such, a coast is entitled to a continental shelf even if it has not claimed an EEZ. However, 'there cannot be a [EEZ] without a corresponding continental shelf. See art 76(1) and 77(3) LOSC. 1985 ICJ Rep 34 at ICJ. *Libyan Arab Jamahiriya/Malta*. Available at: <http://www.icj-cij.org/docket/files/68/6415.pdf> [Accessed 10 January 2017].
- 28 Art. 76(8) of LOSC.
- 29 Art. 56(1)(a), 77(1) and 77(4) of LOSC.
- 30 Abraham, G., 2007. Lines upon maps: Africa and the sanctity of African boundaries. *African Journal of International and Comparative Law*, 15(1), p.72.
- 31 Art. 15 of LOSC.
- 32 Art. 74 of LOSC
- 33 Art. 83 of LOSC.
- 34 See Art. 15, 74(1), (2), (3) and 83(1), (2), (3).
- 35 Art. 74 and 83 of LOSC. See discussion on delimited and un-delimited boundaries on Africa's eastern seaboard in Ntola, S. and Vrancken, P., 2016. The delimitation of maritime boundaries on Africa's eastern seaboard. *Journal of Ocean Law and Governance in Africa*, 1, pp.54-104.
- 36 The agreements are too long to list for present purposes, but are available in UN Maritime space: Maritime zones and maritime delimitation. Available at: <http://www.un.org/Depts/los/LEGISLATIONANDTREATIES/asia.htm> [Accessed 12 December

- 2017]. The case between Bangladesh and Myanmar on delimitation can be found in ITLOS. Dispute concerning delimitation of maritime boundary between Bangladesh and Myanmar in the Bay of Bengal (*Bangladesh/Myanmar*). Available at: https://www.itlos.org/fileadmin/itlos/documents/cases/case_no_16/published/C16-J-14_mar_12.pdf [Accessed 12 December 2017].
- 37 Dispute currently before the ICJ. See ICJ. Maritime delimitation in the Indian Ocean (Somalia v. Kenya). Available at: <http://www.icj-cij.org/en/case/161> [Accessed 12 December 2017].
- 38 See the treaty concerning the joint management of the continental shelf in the Mascarene Plateau region between the Government of the Republic of Seychelles and the Government of the Republic of Mauritius (79 LOSB 41).
- 39 This would be the internal waters, archipelagic waters, territorial seas and EEZs of coastal states. See art 86 LOSC.
- 40 Art 136 LOSC.
- 41 Art 137(1) LOSC.
- 42 Art 156(1) LOSC.
- 43 Art 157(1) LOSC.
- 44 Art 87(1) LOSC.
- 45 Ibid.
- 46 Also see art 90 LOSC.
- 47 Also see art 79(2) and 90 LOSC.
- 48 Ibid.
- 49 Art 87(2) LOSC. This means that states are to refrain 'from any acts that might adversely affect the use of the high seas by nationals of other' states. See Walker, G.K., 2005. Defining terms in the 1982 Law of the Sea Convention IV: The last round of definitions proposed by the International Law Association (American Branch) Law of the Sea Committee. *California Western International Law Journal*, p.174.
- 50 Other limitations include, *inter alia*: the freedom to lay submarine cables and pipelines, as well as the freedom to construct artificial islands, and installations are subject to the rights of the coastal states, should the high seas be above the continental shelf of such state. Also, freedom of the high seas is limited by any bilateral or multilateral treaty binding on the state concerned. See arts 79, 80, 87(1)(c)-(d), 87(2) and 112.
- 51 UN. IMO profile. Available at: <https://business.un.org/en/entities/13> [Accessed 3 March 2017].
- 52 Churchill and Lowe, 1999, p.61.
- 53 Art 17 LOSC.
- 54 Art 18(1) LOSC.
- 55 Art 19(1) LOSC. Art 19(2) lists instances when passage will be considered 'prejudicial to the peace, good order or security of the coastal state'.
- 56 Art 33(2) LOSC.

- 57 Art 33(1) LOSC.
- 58 See 'Exploitation of marine resources' and 'Protecting the marine environment' below.
- 59 Art 60(4)-(7) and 260 LOSC.
- 60 Art 60(7) and 80 LOSC.
- 61 Art 87(2) LOSC.
- 62 Churchill Lowe, 1999, p.284.
- 63 Art 56(1)(a) and 61(1) LOSC.
- 64 Art 63(1) LOSC.
- 65 See, for instance, the IOTC in IOTC. Cooperations with other organisations. Available at: <http://www.iotc.org/about-iotc/cooperation-other-organisations> [Accessed 12 December 2017].
- 66 Art 3(1) 1995 Agreement.
- 67 Art 5(a), (c) and (h) 1995 Agreement.
- 68 See art 8, 9 and 18 1995 Agreement.
- 69 Ibid.
- 70 Art 77(4) LOSC.
- 71 Art 77(2) LOSC. Accordingly, the coastal state has enforcement jurisdiction over its seabed, considering that the continental shelf forms part of the underwater land-mass of a coastal state. See art 76(1) LOSC.
- 72 The CLCS is not a judicial body and its recommendations are not legally binding on the submitting state. However, LOSC provides that a continental shelf beyond 200 nm is to be established on the basis of the CLCS recommendations. 'Practice shows that the recommendations proposed by the [CLCS] have been followed and cited as precedent by the [CLCS] in subsequent submissions.' Consequently, 'this demonstrates the impact that the recommendations of the [CLCS] can have on the determination of the extent of the Area'. On that basis, to establish a continental shelf beyond 200 nm, and contrary to the recommendations of the CLCS, may entail that such establishment is not recognised by the international community of states, as it is without 'legal basis' and, as such, encroaches on the Area, the resources of which are subject to the common heritage of mankind. Art 76(8) LOSC; Yu, J. and Ji-Lu, W., 2011. The outer continental shelf of coastal states and the common heritage of mankind. *Ocean Development and International Law*, 42, p.325.
- 73 On the one hand, 'payments' may be construed as the act of passing on remuneration to discharge an obligation. However, at UNCLOS III, negotiators shied away from 'payment in cash or in kind, [i]nstead, they chose to refer to payments and in kind contributions, suggesting they intended to distinguish between monetary discharges and in kind discharges of the obligation'. On the other hand, 'contributions' do not connote a lesser sense of obligation than payments, but rather offer a more flexible interpretation than payments. Accordingly, by choosing to discharge the obligation by making in kind contributions, the coastal state discharges its obligation in non-monetary form

- of equivalent in value. See Soanes, C. and Stevenson, A. (ed.), 2004. *Concise Oxford English Dictionary*. Oxford: Oxford University Press, p.1051; Nations Convention on the Law of the Sea (2009) 28-29 at ISA. Issues associated with the implementation of article 82 of the United Nations Convention on the Law of the Sea. Available at: <http://www.isa.org.jm/files/documents/EN/Pubs/Article82.pdf> [Accessed 7 February 2017]. What is unclear about discharging the obligation in payments or contributions in kind is whether such decision 'is a one-time decision on the first eligible production or if it can be changed later'. Furthermore, it is presumed that payments have to be made in a convertible currency, however, this is not provided for in the LOSC. See Chircop, A., 2011. Managing adjacency: Some legal aspects of the relationship between the extended continental shelf and the International Seabed Area. *Ocean Development and International Law*, 42, p.309; ISA Technical Study No 4: Issues Associated with the Implementation of Article 82 of the United Nations Convention on the Law of the Sea, p.28-19.
- 74 Two points are unclear with regard to this provision. 'The first concerning the meaning of "annually", which is intended to refer to periodically, and which may be taken to mean the calendar year or financial year, which might not coincide, and both of which might vary from country to country. The second point is that it is likely that the value of the payment or volume of the contribution might vary from year to year in response to market and other conditions. The wide fluctuation of prices of hydrocarbons and other mineral commodities, as well as hard currency values in recent times, suggests there could be a potential issue in the implementation of Article 82. The timing of payments or contributions could potentially and significantly affect the value of the payment or contribution.' 'Value' or 'volume' is interpreted to refer to gross rather than net value or volume. This is because the negotiating history of Art. 82 suggests that the net revenue model proposed by some states was ultimately rejected, owing to other states anticipating difficulty in agreeing upon what costs should be deducted in arriving at the net revenue figure. Further, Art. 82 suggests that the scenarios considered were in relation to hydrocarbons, even though the provision is applicable to any non-living resource and that 'cost-recovery might operate differently in relation to those resources'. The LOSC also provides that production does not include resources used in connection with exploitation. This statement is vague and opaque and is 'intended to imply that developers are expected to recover a substantial portion of their development costs [during the first five years of production]'. Deduction of ongoing production costs until exploitation is brought to an end after the first five years does not appear to have been considered. See: Art. 82(2) LOSC; Chircop, A. and Marchand, B., 2003. International royalty and continental shelf limits: Emerging issues for the Canadian offshore. *The Dalhousie Law Journal*, 26, p.297; Lodge, W., 2006. The International Seabed Authority and article 82 of the UN Convention on the Law of the Sea. *International Journal of Marine and Coastal Law*, 21, pp.323, 327-329. See further Annex. 1 of the Report of

Working Group A on the Implementation Guidelines and Model Agreement Presented by Professor Chircop as Facilitator and Dr Galo Carrera at ISA. Implementation of Article 82 of the United Nations Convention on the Law of the Sea: Report of international workshop convened by the International Seabed Authority in Collaboration with the China Institute for Marine Affairs in Beijing. Available at: <http://www.isa.org.jm/files/documents/EN/Pubs/TS12-web.pdf> [Accessed 17 February 2017].

- 75 Art. 82(3) LOSC. Art 82(4) provides that payments and contributions must be made through the ISA, 'which shall distribute them to States Parties in the Convention on the basis of equitable sharing criteria, taking into account the interests and needs of developing States, particularly the least developed and landlocked among them'. The LOSC uses the word 'through' and not 'to' the ISA, indicating that the final destination of payments or contributions is to State Parties and that the role of the ISA is instrumental in this regard. Also, 'after the State opts to make payments and contributions, there is no indication as to the determination of actual amounts, currency(ies) to be used for payments, delivery of contributions in kind, timing of payments and contributions, and so on'. 'Much will depend on the goodwill of the [coastal State] which has a continuing good faith obligation.' Further, considering the 2016 report of the UNCTAD (http://unctad.org/en/PublicationsLibrary/Idc2016_en.pdf), Bangladesh, the Comoros, Madagascar, Mozambique, Somalia, Tanzania and Yemen may be considered as the least developed countries in IORA, for purposes of Art. 82(4). Art. 300 LOSC; See Annex 6 of ISA Technical Study No 12, 'Potential Options on Equitable Distribution of Payments and Contributions. Paper presented at the Workshop on Further Consideration of the Implementation of the United Nations Convention on the Law of the Sea', at ISA. Implementation of Article 82 of the United Nations Convention on the Law of the Sea: Report of international workshop convened by the International Seabed Authority in collaboration with the China Institute for Marine Affairs in Beijing. Available at: <http://www.isa.org.jm/files/documents/EN/Pubs/TS12-web.pdf> [Accessed 29 February 2017].
- 76 Art 133 LOSC.
- 77 The Enterprise is the organ through which the ISA will carry out functions such as transporting, processing and marketing of minerals recovered from the Area. See art 170 of the LOSC.
- 78 Vrancken, P.H.G., 2011. South Africa and the Law of the Sea. Leiden: Martinus Nijhoff, p.335.
- 79 Art 2(1)(b) Annex III LOSC. See regulations pertaining to overhead charges for administration and supervision of exploration (ISBA/19/A/12), prospecting and exploration of cobalt-rich ferromanganese crusts (ISBA/18/A/11), polymetallic sulphides (ISBA/16/A/12/Rev. 1) and polymetallic nodules (ISBA/19/A/9) at ISA. The mining code. Available at: <https://www.isa.org.jm/mining-code/Regulations> [Accessed 21 February 2017].

- 80 Established pursuant to art 158(2) LOSC. Functions in art 170 LOSC.
- 81 Art 140(2) LOSC.
- 82 Art 158(1) and 159(1) LOSC.
- 83 Art 151(10) LOSC.
- 84 UN. Doc. A/Res/70/1. Transforming our world: The 2030 agenda for sustainable development. Available at: <https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf> [Accessed 1 March 2017].
- 85 Paragraph 14.1 UNSDG.
- 86 Paragraph 14.5 UNSDG.
- 87 Art 192 LOSC.
- 88 Art 193 LOSC.
- 89 Art 1(1)(4) LOSC.
- 90 Churchill and Lowe, 1999, p.284.
- 91 Art 207-212 LOSC.
- 92 Art 197 LOSC.
- 93 The wording of art 197 is broad enough to include other areas of cooperation not expressly provided for in the LOSC, as long as they are consistent with it.
- 94 Art 198-201 LOSC.
- 95 UNDP. Regional seas programme. Available at: <http://web.unep.org/regionalseas/who-we-are/regional-seas-programmes> [Accessed 12 December 2017].
- 96 Pavliha, M. and Martinez Gutiérrez, N.A., 2010. Marine scientific research and the 1982 United Nations Convention on the Law of the Sea. *Ocean and Coastal Law Journal*, 16(1), p.115.
- 97 Ibid; Churchill and Lowe, 1999, p.400.
- 98 Art 250 of the LOSC provides that marine scientific research communication be submitted through official channels. 'Therefore, unless otherwise agreed, requests for a marine scientific research project should be submitted through diplomatic channels'. As such, states or international organisations intending to conduct marine scientific research in the EEZ or on the continental shelf of a coastal state, shall inform the coastal state in no less than six months from the start of the research undertaking of information pertaining to, *inter alia*: the nature and objectives of the project; 'methods to be used, including name, tonnage, type and class of vessels and a description of scientific equipment; and the precise geographical areas in which the project is to be conducted'. Art 248 LOSC; Pavliha and Martinez Gutiérrez, 2010, p.123.
- 99 Art 245 LOSC. This means that ships cannot undertake marine scientific research while exercising their right of innocent passage. To do so would render a ship's passage non-innocent and thus 'prejudicial to the peace, good order or security of the coastal State' (art 19(2)(j) LOSC).
- 100 Art 2(1), 8(1) and 49(1) LOSC.

- 101 Art 40 read with 54 LOSC.
- 102 Art 246(1) LOSC.
- 103 Art 246(2) LOSC.
- 104 Art 246(3) LOSC.
- 105 Art 246(4) LOSC.
- 106 Churchill and Lowe, 1999, p.407.
- 107 Pavliha and Martinez Gutiérrez, 2010, p.122.
- 108 Art 246(5) LOSC.
- 109 See 'Maritime zones beyond national jurisdiction', above.
- 110 Art 87(1)(f) LOSC.
- 111 Those states that undertake scientific research in the Area must promote international cooperation with regard to marine scientific research in the Area by: (a) participating in international programmes and encouraging cooperation in marine scientific research by personnel of different countries and of the [ISA]; (b) ensuring that programmes are developed through the [ISA] or other international organisations as appropriate for the benefit of developing states and technology less developed states [...]; and effectively disseminating the results of research and analysis when available, through the [ISA] or other international channels when appropriate. Art 143(3) LOSC.
- 112 Art 143(1) LOSC.
- 113 The ISA may also carry out marine scientific research concerning the Area and its resources. Art 143(2) LOSC.

African Governance Perspectives of the Blue Economy in the Indian Ocean Rim

Siqhamo Yamkela Ntola and Patrick Vrancken

Introduction

The concept of a 'Blue Economy' recognises that the productivity of healthy freshwater and ocean ecosystems is a pathway to sustainable economic growth for aquatic and maritime-based economies.¹ In terms of these economies, the Blue Economy is 'envisaged as the integration of ocean economy development with the principles of social inclusion, environmental sustainability and innovative, dynamic business models'.² Not only does the Indian Ocean have a wealth of living and non-living resources, but it is the world's pre-eminent seaway for trade and commerce. It is against this backdrop that the principles of the development of a Blue Economy in the Indian Ocean region need to be articulated. These principles are supported by the objectives of the Indian Ocean Rim Association (IORA),³ which is founded, *inter alia*, on the principle of facilitating and promoting economic co-operation, 'bringing together [...] representatives of Member States' governments, businesses and academia. In a spirit of multilateralism, the Association seeks to build and expand understanding and mutually beneficial co-operation through a consensus-based, evolutionary and non-intrusive approach'.⁴

Coastal and national economies in the Indian Ocean region are expected to derive huge benefits from the development of the Blue Economy, which will exploit the vast untapped potential of the Indian Ocean. In this way, IORA Member States will enjoy a greater share of the global gross domestic product (GDP), rather than the small percentage that they currently enjoy,⁵ and the region will attract more economic development. The Blue Economy is expected to generate new jobs, skill sets and capacity, as well as contribute to sustainable development and the mitigation of climate change. None of this will be achieved without collaboration across IORA Member States, particularly in the priority areas identified by the IORA

Secretariat such as fisheries and aquaculture, renewable ocean energy, seaports and shipping, and seabed exploration and minerals extraction.

Of the 21 Member States of the IORA, African States constitute the second largest regional group, with 9 (or 43 per cent)⁶ States, compared with 11 (or 52 per cent)⁷ Member States in the Asia-Pacific group and 1 (or 5 per cent) in the Western European group.⁸ The IORA objectives encapsulate the economic aspirations of the developing states in the first two groups.⁹ The IORA African Member States that have adopted deliberate measures to develop a Blue Economy within their jurisdiction have generally been guided by continental and regional governance frameworks that are aimed at integrating the continent economically and bringing about economic, social and cultural development.

Before describing the continental and regional policy and legal frameworks that speak to the concept of the Blue Economy, this chapter provides a brief background on the extent to which IORA African Member States are exposed to the Indian Ocean, and how their cognisance of such exposure (and the consequent potential benefits) has informed their contributions to the global legal regime governing ocean spaces. The chapter will also elaborate on the national perspectives of Mauritius, the Seychelles and South Africa on the Blue Economy.

Background

IORA African Member States have a combined coastline of 15 091 km, unevenly divided among them. Of the 9 States, namely Comoros, Kenya, Madagascar, Mauritius, Mozambique, the Seychelles, Somalia, South Africa and Tanzania, four have a coastline of less than 1000 km, with Mauritius having the shortest coastline at 177 km.¹⁰ The remaining five States have a coastline longer than 1000 km, with Madagascar having the longest coastline at 4828 km.¹¹ Considering the poor economic and socio-economic conditions of these States, it is not surprising that the states wish to exploit their exposure to the Indian Ocean while ensuring the sustainability of ocean resources within their national space. Indeed, east African coastal states have focused on this sector since the wave of independence swept through the continent. Their aim was to reform the classical law of the sea, which had been developed during the colonial period following a largely *laissez faire* approach, with most of the oceans falling under the regime of the freedom of the high seas.¹² This was largely codified under the 1958 Geneva Conventions on the Law of the Sea. Indeed, the contributions of some east African coastal states in global forums leading up to and during the Third United Nations Conference on the Law of the Sea (UNCLOS III) were instrumental in the adoption of those provisions of the 1982 United Nations Law of the Sea Convention (LOSC),¹³ which endorses

Blue Economy development.¹⁴ For example, in the exclusive economic zone (EEZ), the LOSC provides that a coastal state has the exclusive right to explore, exploit, conserve and manage the natural resources therein, whether living or non-living.¹⁵ The LOSC is an important global instrument, as it provides the global legal framework for a Blue Economy.¹⁶ Since its adoption and coming into effect,¹⁷ all IORA African Member States have ratified the LOSC¹⁸ and, for the most part, established the legal zones for which it makes provision, such as the territorial sea¹⁹ and the EEZ,²⁰ where the majority of the ocean activities of these states will be undertaken.

Establishment of the latter zone (EEZ) is not limited to its waters, but extends to the seabed and subsoil of the continental shelf, the rights upon which are not dependent on 'occupation, effective or notional, or any express proclamation'.²¹ The continental shelf may not extend beyond 200 nautical miles, unless recommendations to that effect have been made by the Commission on the Limits of the Continental Shelf (CLCS).²² In instances where the established legal zones overlap with those of a neighbouring State with an opposite or adjacent coastline, the LOSC provides for methods for delimitation.²³ This is necessary as undefined boundaries create uncertainty as to which coastal state has sovereignty over the disputed area, and have the effect of hampering economic development in that ocean space. An apt example would be the maritime delimitation dispute between Kenya and Somalia before the International Court of Justice.²⁴

At a continental level, the manner in which African Member States of the IORA are required to operate is provided for in continental governance frameworks such as the 2050 Africa's Integrated Maritime Strategy (2050 AIM Strategy),²⁵ as well as the regional frameworks of the Common Market for Eastern and Southern Africa (COMESA),²⁶ East African Community (EAC),²⁷ Intergovernmental Authority on Development (IGAD)²⁸ and South African Development Community (SADC).²⁹ Other regional frameworks include, the 1985 Nairobi Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern Africa region ('the Nairobi Convention')³⁰ and the Indian Ocean Memorandum of Understanding on Port State Control ('MoU on Port State Control').³¹

Continental Governance Frameworks

Policy Frameworks

2050 AIM Strategy

By 2063, as articulated in Agenda 2063, the African people, on the continent and in the diaspora, envision, among other things, '[a] prosperous Africa based

on inclusive growth and sustainable development’ as well as a peaceful and secure continent.³² The 2050 AIM Strategy is the road map crafted by African leaders to effectively utilise Africa’s ocean space to meet the aspirations outlined in the Agenda. The Strategy ‘is an African-driven long-term and reasonably comprehensive vision crafted to better harness Africa’s so-called “Blue Economy”, with the vision of using this to promote development in the continent’.³³ Its adoption is a productive step towards unlocking Africa’s economic potential at sea. Its strategic objectives include: establishing a Combined Exclusive Maritime Zone (CEMZA); engaging civil society and all other stakeholders to improve awareness of maritime issues; enhancing political will at a community, national, regional and continental level; ensuring security and safety of maritime transportation systems; and minimising environmental damage and expediting recovery from catastrophic events.³⁴

In line with its objectives, the 2050 AIM Strategy outlines its ‘framework for strategic action’. That is to say, it articulates the activities and outcomes necessary for its implementation. These activities include, *inter alia*:

- establishing the CEMZA with the aim of boosting intra-African trade;³⁵
- sustainably managing fish stocks in the CEMZA, once it is established;³⁶
- developing an integral human resources strategy for the maritime sector to support the provision of skills, taking into account gender balance in the entire maritime chain, which includes shipping and logistics, offshore activities, fishing, tourism and recreation, as well as safety and security;³⁷
- utilising the African Union (AU) Border Programme, in accordance with the LOSC, to peacefully resolve existing maritime boundary disputes and encourage States to claim their maritime space, including the extended continental shelf;³⁸
- improving maritime governance in areas such as environmental crime,³⁹ environmental and biodiversity monitoring,⁴⁰ flag and port state control,⁴¹ marine spatial planning,⁴² piracy and armed robbery at sea;⁴³
- creating wealth from the African Maritime Domain, in order to reap economic benefit and advance sustainable socio-development;⁴⁴ and
- improving maritime trade and competitiveness, which involves, *inter alia*, supplementing existing ports systems to improve trade.⁴⁵

Legal frameworks

Treaty Establishing the African Economic Community

The 1991 Treaty Establishing the African Economic Community (AECT),⁴⁶ which has been ratified by most African Member States of the IORA,⁴⁷ captures

the ambition of African States and their leaders to integrate the continent economically,⁴⁸ 'thereby leading to increased economic self-reliance and greater economic opportunity'.⁴⁹ As such, the objectives of the African Economic Community (AEC)⁵⁰ encapsulate not only the vision of African leaders, but the concept of a Blue Economy. The objectives of the AEC include, among other things, promoting economic, social and cultural development and integrating African economies 'in order to increase economic self-reliance and promote an endogenous and self-sustained development';⁵¹ 'promot[ing] cooperation in all fields of human endeavour in order to raise the standard of living of African peoples, and maintain and enhance economic stability, foster close and peaceful relations among Member States and contribute to the progress, development and the economic integration of the continent';⁵² and 'coordinat[ing] and harmoniz[ing] policies among existing and future economic communities in order to foster the gradual establishment of the community'.⁵³

The Treaty establishing the African Economic Community (AECT) identifies Regional Economic Communities (RECs) as important vehicles for the realisation of the objectives of the AEC. Strengthening existing RECs and establishing new ones was set as a priority.⁵⁴ Further, Article 28(2) of the AECT directs Member States to take 'all necessary measures aimed at progressively promoting increasingly close co-operation among the communities, particularly through co-ordination and harmonisation of their activities in all fields or sectors in order to ensure the realisation of the objectives of the Community'. Areas identified for coordination and harmonisation include food and agriculture,⁵⁵ which involves the development of fisheries to ensure food security;⁵⁶ science, technology, energy, natural resources and the environment;⁵⁷ as well as transport and tourism.⁵⁸

The AECT is an important pillar in Africa's developmental framework, to the extent that its provisions resonate in the founding instrument of the African Union (AU),⁵⁹ the 2000 Constitutive Act (AUCA).⁶⁰

The AU Constitutive Act

The adoption of the AUCA was preceded by the 'Sirte Declaration', which followed the Fourth Extraordinary Session of the Organisation of African Unity (OAU) in 1999. The session was convened '[to] discuss ways and means of making the [OAU] more effective so as to keep pace with the political, economic and social developments taking place within and outside [the] continent'.⁶¹ In fact, establishing the AU was viewed as 'Africa's collective response to the phenomenon of globalisation' and thus the need to 'reposition the OAU in the international scheme of things, reorient its objectives, and put in its place a new mechanism in order to reinvigorate the project of African integration [...]'.⁶²

In reinvigorating the then OAU to establish the AU, State Parties, as indicated above, leaned on the principles and objectives of the AECT.⁶³ With particular regard to economic integration, the objectives of the AECT are echoed in the existing AU framework. In this regard, the AUCA sets out to integrate African economies through harmonised policies between existing and future RECs. Blue Economy development, in the manner envisioned in the 2050 AIM Strategy, will contribute towards meeting the objectives outlined in the AECT and AUCA.

Maritime Transport Charter

The 2009 African Maritime Transport Charter (AMTC)⁶⁴ was adopted⁶⁵ following the First Conference of African Ministers Responsible for Maritime Transport in Africa.⁶⁶ The Charter is a revision of the 1994 instrument,⁶⁷ the purpose of which was to provide a cooperative framework among African States, as well as between African and non-African States, to improve the poor state of the maritime sector in Africa.

The AMTC directs the AU to establish a Continental Unit to coordinate regional cooperation in shipping and port operations⁶⁸ as well as the establishment by Member States of an Association of African Maritime Administrations (AAMA).⁶⁹ Member States are directed to cooperate in implementing relevant legislation in the field of maritime transport, inland waterways and port operations.⁷⁰ Member States also ‘undertake to put in place an efficient maritime communication network in order to make optimum use of mechanisms for control, follow-up and intervention at sea and ensure better organisation of maritime traffic’.⁷¹ Further, Member States are expected to ‘strive to create a strategic framework to encourage the exchange of information in order to enhance measures that can improve the safety, security and prevention systems and make it possible to combat unlawful acts perpetrated at sea’.⁷² To date, only Kenya⁷³ and Mauritius⁷⁴ among the African Member States of IORA have ratified the Charter.⁷⁵

Lomé Charter on Maritime Security

As recently as 15 October 2016, The African Heads of State and Government adopted the African Charter on Maritime Security and Safety and Development in Africa.⁷⁶ The Charter ‘aims to solidify Africa’s commitment to an efficient and effective management of its oceans, seas and waterways, so as to ensure sustainable, equitable and beneficial exploration of these critical resources’.⁷⁷ The Charter covers

- a) the prevention and control of all transnational crime at sea, including terrorism, piracy, armed robbery against ships, drug trafficking, smuggling

- of migrants, trafficking in persons and all other kinds of trafficking, IUU fishing, prevention of pollution at sea and other unlawful acts at sea, under the jurisdiction of a States Party in its area of responsibility;
- b) all measures to prevent or minimise accidents at sea caused by ships or crew or aimed at facilitating safe navigation; [and]
 - c) all measures for the sustainable exploitation of marine resources and the optimisation of the development opportunities of sectors related to the sea.⁷⁸

In line with its scope, the Charter provides for measures to prevent and combat crime at sea, which include, *inter alia*, each State Party undertaking to organise its actions at sea and to develop its capacity to protect its maritime areas,⁷⁹ as well as to 'harmonise its national laws to conform with relevant international legal instruments including [the LOSC], SOLAS and the Protocol of the 2005 Convention for the Suppression of Unlawful Acts Against the Safety of Maritime Navigation'.⁸⁰

Regional frameworks

Regional Instruments

The Nairobi Convention

The Nairobi Convention was adopted under the auspices of the United Nations Environment Programme (UNEP), Regional Seas Programme (RSP). The UNEP-RSP's objective is to protect the health of the world's oceans by developing treaties as well as rules and standards at a regional level.⁸¹ The programme was 'conceived as an action-oriented programme encompassing a comprehensive, trans-sectoral approach to marine and coastal areas and to environmental problems, considering not only the consequences, but also the causes of environmental degradation'.⁸² Currently, there are 18 regional programmes, including that of the east Africa region,⁸³ the region where the Nairobi Convention applies.⁸⁴ All African Member States of the IORA are Contracting Parties to the Nairobi Convention.⁸⁵

The Convention generally directs Contracting Parties, both individually and jointly, to

'take all appropriate measures in conformity with international law and in accordance [with it] and those of its protocols [...] to prevent, reduce and combat pollution of the Convention area and to ensure sound environment management of natural resources, using for this purpose the best practicable means at their disposal, and in accordance with their capabilities'.⁸⁶

The Convention then goes on to provide specific sources of pollution where such measures should apply, namely pollution from ships, dumping, land-based sources and activities, seabed activities, airborne pollution, pollution from the transboundary movement of hazardous waste, as well as environmental damage from engineering activities.⁸⁷ Further, contracting parties must cooperate 'in the formulation and adoption of protocols to facilitate the effective implementation of [the] Convention'.⁸⁸ Currently, only two protocols have been adopted, namely the 1985 Protocol Concerning Cooperation in Combating Marine Pollution in Cases of Emergency in the Eastern African region⁸⁹ and the 1985 Protocol Concerning Protected Areas and Wild Fauna and Flora in the Eastern Africa region.⁹⁰

MoU on Port State Control

The 1998 Memorandum of Understanding on Port State Control for the Indian Ocean region,⁹¹ 'Port State Control' (PSC), is a regime for the inspection of foreign ships in other national ports by Port State Inspectors. The purpose of such inspections is to ensure compliance with international instruments such as the:

- 1974 International Convention for the Safety of Life at Sea (SOLAS);⁹²
- 1973 International Convention for the Prevention of Pollution from Ships (MARPOL);⁹³
- 1978 International Convention on Standards of Training, Certification and Watchkeeping for Seafarer (STCW);⁹⁴ and
- 2006 Maritime Labour Convention (MLC).⁹⁵

The regime generally speaks to safety at sea with regard to navigation, safe labour conditions on board vessels and marine environmental protection.⁹⁶ The regime has proven effective, thus enhancing the efficiency of inspection programmes. Owing to this, the International Maritime Organisation adopted a resolution,⁹⁷ in 1991, that promotes regional cooperation and coordination in the form of memoranda of understanding (MoU) between the maritime authorities of States located in, or involved in, a particular region. The conclusion of these agreements between maritime authorities means that the obligations emanating from them give effect to international shipping regulations.⁹⁸ The Indian Ocean MoU on Port State Control is one such agreement.

Under the MoU on Port State Control, with the exception of the maritime authorities of Madagascar, Seychelles and Somalia's, the authorities⁹⁹ of the remaining African IORA Member States have undertaken to conduct inspections on a certain percentage of vessels visiting their ports within a specified time-frame. The authorities are to 'satisfy themselves that the crew and the overall condition

of the ship, its equipment, machinery spaces and accommodation and hygienic conditions on board, meet the provisions of the relevant instruments'.¹⁰⁰

Regional economic communities

As mentioned earlier, RECs are an important vehicle for realising the AEC. RECs 'are intergovernmental organisations set up by groups of countries to foster stronger economic ties and cooperation'.

Generally, as indicated in their founding instruments, the RECs to which African Member States are party seek to advance economic and socio-economic development through cooperation in areas such as energy, natural resources, trade, transport and tourism.¹⁰¹ The EAC and SADC have gone further than articulating their objectives in their founding instruments.

For instance, the EAC adopted its 'Vision 2050',¹⁰² which articulates the EAC's desired future end state. Vision 2050 provides 'an architecture around which the EAC should concentrate its energies for economic and social development',¹⁰³ identifying as its pillars the areas of cooperation highlighted in its Treaty, such as infrastructure development, which includes maritime and port development, food security, and environmental and natural resource management.¹⁰⁴

SADC's Treaty directs its Member States to conclude protocols in 'each area of co-operation, which will spell out the objectives and scope of, and institutional mechanisms for, co-operation and integration'. SADC Member States have concluded protocols on energy,¹⁰⁵ fisheries,¹⁰⁶ mining,¹⁰⁷ tourism,¹⁰⁸ trade¹⁰⁹ and wildlife conservation.¹¹⁰ Indeed, the regional governance frameworks of the RECs are broad enough to encompass the development of a Blue Economy in the respective regions. In fact, SADC officials have gone so far as to confirm that the objectives of a Blue Economy are in line with its developmental priorities and have called for the region to 'align its programmes and strategies with the ideals of the Blue Economy', so as to 'allow the region to maximise benefits from the achievement of a sustainable pattern of development and utilisation of oceanic resources'.¹¹¹

National perspectives

Introduction

At a national level, Mauritius, the Seychelles and South Africa are the African Member States of the IORA that have made relatively significant advances in terms of adopting and implementing a domestic governance framework that is

conducive to Blue Economy development. The other African States have expressed their desire to move in the same direction. For instance, Kenya has indicated that fisheries management is among its top priorities and that it seeks to develop capacity to access EEZ fisheries ‘in line with the Regional Strategy to Address Issues of Sustainable Management and Development of Fisheries Resources in the IOR region’.¹¹² Madagascar has identified ‘tourism as the cornerstone of its economic development’,¹¹³ with Somalia emphasising the importance of safety and security at sea for effective trade and investment facilitation, fisheries management, tourism and cultural exchange.¹¹⁴ Indeed, in its post-conflict State, Somalia and its partners have successfully reduced incidents of piracy off Somalia’s coast.¹¹⁵

To that end, the sub-sections below outline the Blue Economy policy and legal frameworks of Mauritius, Seychelles and South Africa.

Mauritius

Mauritius’ commitment to developing an oceans economy is evidenced by its ‘Government Programme 2015-2019’, which aims to transform Mauritius into an ocean state by promoting the ocean economy as one of its main pillars.¹¹⁶ Key investment opportunities identified under the Mauritius ocean economy include seabed exploration for hydrocarbons and minerals, fishing, seafood processing and aquaculture, deep ocean water applications, seaport related activities, marine renewable energies and ocean knowledge.

Mauritius has also entered into a joint development agreement with the Seychelles over the extended continental shelf area in the Mascarene Plateau region.¹¹⁷ The agreement follows Mauritius and the Seychelles’ joint submission to the CLCS claiming a continental shelf beyond 200 nm.¹¹⁸ Mauritius and the Seychelles have undertaken to jointly ‘control, manage and facilitate the exploration of the continental [...] and the conservation, development and exploitation of its natural resources’;¹¹⁹ that is to say,

the mineral, petroleum and other non-living resources of the seabed and subsoil of the continental shelf together with living organisms belonging to sedentary species that are at the harvestable stage either immobile on or under the seabed or are unable to move except in constant physical contact with the seabed or subsoil.¹²⁰

The Seychelles

As evidenced by the aforementioned joint development agreement with Mauritius, the Seychelles has embraced the concept of a Blue Economy ‘as a mechanism to realise sustainable economic development based around an ocean-based economy’.¹²¹

The Seychelles has a dedicated agency to develop and implement a 'National Blue Economy Roadmap' that will steer it towards economic diversification, job creation and achieving food security, whilst sustainably managing the marine environment.¹²² The Seychelles has also initiated a Blue Economy Research Institute that will 'build local capacities, enhance scientific understanding to contribute to local and international conservation and sustainable development efforts'.¹²³

South Africa

Developing an oceans economy has been identified as critical to fast-tracking the implementation of South Africa's National Development Plan. Accordingly, in 2014, South Africa launched 'Operation Phakisa', an initiative designed to unlock South Africa's ocean economy by growing areas such as aquaculture,¹²⁴ transport and manufacturing,¹²⁵ as well as offshore oil and gas.¹²⁶ Marine protection services and ocean governance have also been identified as important pillars for ensuring environmental and economic sustainability, thus aligning with the Blue Economy outlook.

Operation Phakisa 'allows for an assessment and prioritization of specific blue economy intervention areas. It is very-goal specific and focussed on the achievement of national development goal targets [...], with specific outcomes that centre on ensuring inclusiveness, participation, job creation, value addition, and links to industrialization, particularly in the aquaculture sector'.¹²⁷ Regarding the latter, South Africa has moved decisively in strengthening its governance framework in the sector, as is evidenced by the publication of the Draft Aquaculture Bill¹²⁸ for public comment in February 2017. South Africa has also published a Draft Marine Spatial Planning Bill,¹²⁹ which aims to develop a marine spatial plan for its waters and to govern the use of the ocean by multiple sectors. To provide high-level direction for undertaking marine spatial planning in the context of its laws and policies as well as existing planning regimes, South Africa published the Draft Marine Spatial Planning Framework¹³⁰ for public comment, in August 2017.¹³¹

Conclusion

The continental and regional governance framework applicable to African Member States of the IORA accommodates Blue Economy development. SADC's call for deliberate action to align Blue Economy principles with its objectives recognises the calibre of contribution that a sustainable oceans economy can make to economic and socio-economic development in the region. Considering the similarity of its

objectives to those of COMESA, EAC and IGAD, such action is necessary in these regions to align and strengthen east African cooperation in ocean activities.

The measures taken by Mauritius, the Seychelles and South Africa in developing an oceans economy, as well as the intention of the other African IORA Member States to undertake similar measures, demonstrate the extent of the political weight behind the Blue Economy movement and bode well for the Blue Economy vision of Africa and the Indian Ocean Rim.

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- 3 Art 3 IORA Charter at IORA. Charter of the Indian Ocean Rim Association (IORA) Available at: http://www.iora.net/media/163271/iora_charter.pdf [Accessed 2 November 2016].
- 4 Art 2 IORA Charter.
- 5 Lyondon, E., English, S. and Barnell, S., 2016. A Roadmap to a sustainable Indian Ocean Blue Economy. *Journal of the Indian Ocean Region*, 12(1), p.53.
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- 7 Bangladesh, India, Indonesia, Iran, Malaysia, Oman, Singapore, Sri Lanka, Thailand, United Arab Emirates and Yemen. With the inclusion of Pakistan, Maldives and Myanmar as Member States, the Asia-Pacific group would amount to 14 (or 56%) of the 25 eligible Member States of the IORA. See Art. 4(a) IORA Charter for eligibility criteria.
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 - 12 Rothwell, R.R. and Stephens, T., 2016. *The International Law of the Sea*. 2nd ed., Sydney: Bloomsbury Publishing, p.2-10.
 - 13 1833 UNTS 3, (1982) 21 ILM 1245.
 - 14 Some of these forums included the OAU Educational, Scientific, Cultural and Health Commission (OAU-ESCHC), and the Yaoundé Regional Seminar, where calls were made to extend the maritime jurisdiction of coastal States to a maximum distance of 200 nm from the baseline of the territorial sea. During UNCLOS III negotiations, Kenya, Madagascar and Tanzania co-sponsored a proposal advocating the establishment of an EEZ, with Mauritius also co-sponsoring a working paper on the EEZ in the same year. For the OAU-ESCHC resolution, see OAU Doc. ESCHC/63 recommendation XVI. Available in Rembe, N., 1980. *Africa and the international law of the sea: A study of the contribution of the African States to the third United Nations Conference on the Law of the Sea*. Leiden: Sijthoff & Noordhoff, pp.216-17. For the Yaoundé Regional Seminar resolution, see UN Doc Leg. Ser. B/16. Available in Oda, S., 1976. *The international law of ocean development: Basic documents vol II*. Leiden: Sijthoff, p.23. For Kenya, Madagascar and Tanzania's co-sponsored proposal, see UN Doc. A/CONF.62/C.2/L.82. Available in Oda, 1976, pp.252-253. For the working paper co-sponsored by Mauritius, see UN Doc. A/CONF.62/C.2/L.82. Available in Platzöder, R. (ed.), 1984. *Third United Nations Conference on the Law of the Sea: Documents Vol V*. New York: Oceana Publications, pp.184-185.
 - 15 Art. 56(1)(a) LOSC.
 - 16 Other continental instruments that are relevant to specific aspects include: the African

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- 19 Art 3 LOSC. For territorial seas established by African Member States of the IORA, see art 3 of statute no 82-005 relating to the delimitation of the maritime zones of the Islamic Federal Republic of the Comoros of 1982. Available at: http://www.un.org/Depts/los/LEGISLATIONANDTREATIES/PDFFILES/COM_1982_Law.pdf [Accessed 6 January 2017]. Also see art 1 of decree no 10-092 of 13 August 2010 establishing the limits of the territorial sea of the Union of the Comoros (2011 74 *LOS* 16); and for Kenya, part II s 3(1) of chapter 371 of the Maritime Zones Act of 1989. Available at: http://www.un.org/Depts/los/LEGISLATIONANDTREATIES/PDFFILES/KEN_1989_Maritime.pdf [Accessed 6 January 2017]; Art. 1 of Ordinance no. 85-013 determining the limits of the maritime zones (territorial sea, continental shelf and exclusive economic zone) of the Democratic Republic of Madagascar of 1985 as amended and ratified by Statute no. 85-013 of 1985 (1986 7 *LOS* 42); s 7 of the Maritime Zones Act, 2005 (Act 2 of 2005), of Mauritius (2006 62 *LOS* 52); Art. 4(2) of Mozambican statute no 4/96 of 1996. Available at: Portuguese at <http://faolex.fao.org/docs/pdf/moz22054.pdf> [Accessed 7 January 2017]; s 4 of the Maritime Zones Act, 1999 (Act 2 of 1999), of Seychelles (2002 48 *LOS* 18); s 4(1) of the Maritime Zones Act, 1994 (Act 15 of 1994), of South Africa ((1996) 32 *LOS* 78); s 3(2) of the Territorial Sea and Exclusive Economic Zone Act, 1989, of Tanzania (1989 13 *LOS* 38). Somalia claimed a 200 nm territorial sea in terms of Art. 1(1) of Statute No. 37 on the territorial sea and ports of 1972. However, the outer limit was later brought back to 12 nm, in terms of Statute No. 5 of 1989, thus approving the Somali maritime statute of 1988 (see paragraph 7 of the application instituting proceedings before the ICJ in the Maritime Delimitation in the Indian Ocean (Somalia v Kenya) case on 28 August 2014 at ICJ. Maritime delimitation in the Indian Ocean. Available at: <http://www.icj.org/docket/files/161/18362.pdf> [Accessed 6 January 2016].

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- 21 Art 77(3) LOSC.
- 22 Art 76(8) LOSC.
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- 35 Establishing the CEMZA will also eliminate or simplify administrative processes in intra-AU maritime transport, with the aim of making it more attractive, efficient and competitive. See paragraph XII (a) 2050 AIM Strategy.
- 36 The AU intends to build on NEPAD's 2005 Abuja Declaration on Sustainable Fisheries and Aquaculture in Africa, the 2010 Conference of African Ministers of fisheries and Aquaculture and UN Conservation and Fish Stocks Management agreements. See paragraph XII (d) 2050 AIM Strategy.
- 37 The AU is directed to set up a 'research exercise that will link up with member states' human resources development agendas as well as explore economic growth and job creation opportunities more widely along the maritime value chain'. Further, it must protect current employment generation levels and enable growth and development across all sectors of the maritime industry. See paragraph XII (g) 2050 AIM Strategy.
- 38 The 2050 AIM Strategy further urges Member States 'to accept and fulfil all those responsibilities that emanate from the establishment of maritime zones, as foreseen by [LOSC] and the IMO SOLAS Convention'. See paragraph XII (j) 2050 AIM Strategy.
- 39 This involves the AU developing mechanisms to detect and prosecute the dumping of toxic waste in African waters, with a tough stance on compensation. The strategy will support, among other things, the NEPAD Joint Implementation Mechanism and the Nairobi Convention. See paragraph XII (k)(iv) 2050 AIM Strategy.
- 40 This involves 'the preservation of the variety of life by a) ensuring the sustainable use, conservation and regeneration of the maritime resources, b) promoting the economical, social and environmental importance of the sea and inland water ways, c) establishing a set of indicators to evaluate the sustainable performance of the activities

- and their monitoring'. The support of Regional Economic Communities is identified as integral for inventory knowledge as well as understanding natural and artificial changes in the African Maritime Domain's biodiversity. See paragraph XII (k)(xiv) 2050 AIM Strategy.
- 41 This involves leveraging initiatives such as Port State Control MoUs. The AU is directed to 'work towards complementing the RECs/RMs and Flag States towards eradicating the operation of sub-standard shipping practices and to enhance security and safety, protection of the marine environment from pollution and improvement of the working and living condition of personnel on board ships. Furthermore, building on the 2009 FAO's Port State Measures Agreement (PSMA) to prevent, deter and eliminate IUU fishing, the AU [will] work towards ensuring that Member States accede to these Agreements as well as solicit the support of partners in the implementation of Article 22 (Requirements of Developing States).' Paragraph XII (k)(vi) 2050 AIM Strategy.
 - 42 This involves mapping activities to determine which maritime activities will be undertaken in certain spaces. Paragraph XII (k)(xiii) 2050 AIM Strategy.
 - 43 The AU is directed to encourage its Member States to repress piracy and armed robbery against ships in a manner that is consistent with their available resources, laws and regulations and applicable rules of international law. Paragraph XII (k)(ix) 2050 AIM Strategy.
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CHAPTER 8

Challenges of Indian Ocean Governance

The Context of the Seychelles

Dennis Hardy

Full realisation of the Blue Economy is dependent on various factors, not least of all the existence of a just and effective system of ocean governance. This is essential to provide at least the same levels of security, codes of behaviour and common understanding of the rule of law as is normally evident on land. At present, a wide gulf exists between the effectiveness of governance on land and that at sea. For a variety of reasons, the latter is not as effective as the former; therefore, the system of ocean governance needs strengthening in many ways and it is the purpose of this chapter to indicate how this might be done. There will be many challenges along the way, but, with sufficient political will, these can be overcome.

A case study, the Republic of Seychelles, is used to illustrate some of the general arguments. An added reason for focusing on Seychelles, is that although it is a small nation (small in terms of its land area and population, rather than in terms of the extensive area of the ocean over which it has jurisdiction, it is making the most of the existing regulatory context. In addition to working with other small island states on matters of common interest, various of its initiatives are laying the foundation for a viable Blue Economy. As such, the Seychelles provides a revealing study of different aspects of ocean governance and is an exemplar, not only for small island states, but for other seaboard nations.

The chapter concludes with the view that all levels of governance need to be strengthened and the potential role of the region needs to be recognised.

Who owns the oceans?

*Man marks the earth with ruin – his control stops with the shore.*¹

As the romantic poet and traveller, Lord Byron, observed some two centuries ago, although humans despoiled the land, at least their intervention largely stopped at the shore. This latter situation has since changed, which is why the subject of ocean governance is now so important. Much damage has already been inflicted on the marine environment and this cannot be allowed to continue if the Blue Economy is to achieve its potential. Yet who is to say what can be permitted at sea and how this can be regulated? How can the voices of small nations be heard amidst the tumult of larger states? In short, who owns the oceans?

So many questions, but where to start? The challenges are, indeed, formidable. It is true that essential building blocks for a comprehensive system of ocean governance are being put into place, but, to date, progress has been partial and, in various respects, not necessarily effective. This critique is explored further in the following pages, but for now it is instructive to consider why more has not been achieved. After all, there is no shortage of evidence to demonstrate the imperfect state of the world's oceans, whether it be measured in terms of the impact of waste disposal or over-fishing, the loss of species or threats to shipping through localised piracy.² Unlike the situation on land, however, the means to control and ameliorate the situation are lacking.

One reason for the absence of effective controls is that the sea has traditionally been viewed as marginal to *terra firma*. For individuals, the land is where everything that is important happens: it is the place of home and (for most people) of work, a place of physical security and familiarity. In contrast, the sea is an undefinable 'other', a vast space without boundaries that is fraught with danger. Similarly, for nations, land provides the source of most of their wealth, clearly defined by boundaries that are recognised in international courts of law. The sea is too often seen as an additional resource, largely free for the taking with relatively few responsibilities attached to it.

A second reason for limited governance is purely physical, the view of the sea from the shore being circumscribed by a distant horizon. Beyond this horizon is a great unknown - out of sight and, to all intents and purposes, out of mind. Seasoned mariners say that a person's psyche changes when the coastline is out of sight and one enters a world seemingly of one's own. This physical and psychological reality is endorsed by a legal reality too: beyond a nation's immediate 'territorial waters' and the more extensive 'exclusive economic zones' (both recognised in international law) the framework of order breaks down. The open sea is beyond any one jurisdiction; in the worst of all possible situations, it belongs

to everyone and no-one. The extent of what is known as the ‘high seas’ (beyond national waters) and their associated vulnerability to misuse is a matter of growing concern:

The largest, least-protected places on our blue planet are found in the high seas – the open ocean and deep seabed area that lie beyond national jurisdictions. They cover about 45% of the Earth’s surface, and 64% of the oceans. Belonging to no single nation, they have been, for too long, neglected by all.³

Only recently have initiatives been taken to provide a measure of protection for these vulnerable and bio-diverse areas that together extend over so much of the planet.

A further physical factor is the sheer scale of the oceans: measured not simply in terms of the extent of the planet’s surface that they cover, but also in terms of their hidden third dimension. If the sheer volume of these waters alone were to be taken into account that would be a challenge enough for governance, but added to this is the fact that so little is known about what this vast sub-marine world contains. Descending not only to the deepest waters but also to the topography of the ocean floor and even to what lies beneath that, the task of understanding – let alone administering – the combined mass is a further challenge to achieving an effective system of ocean governance.

A third reason lies in the weak controls at sea, which are also a result of the promotion of national interests over international ones. International agreements of any kind are notoriously difficult to achieve and are usually concluded only after protracted negotiations over a long period, typically with compromises and trade-offs to bring everyone on board. The danger is that the concessions may be made at the price of an effective and holistic solution. In this context, ocean governance will never be a perfect system, but it could certainly be better than it is now. Recalling the adage that the excellent drives out the good, perhaps the best that can be hoped for is an outcome that is ‘good’. That, at least, would be a worthy aspiration.

For these different reasons, less has been done to manage the oceans responsibly than their despoiled condition calls for. The sea covers a much larger area than the land, yet less is known of it, and ownership is an elusive concept: the challenges cannot be over-stated.

In the following section, an account is given of what has actually been achieved, despite these challenges. It will be seen that, although some progress has been made in managing the oceans, advances remain limited and piecemeal in extent.

Who governs the oceans?

Now, in the legal phraseology of the Law of Nations, the sea is called indifferently the property of no-one (res nullius), or a common possession (res communis), or public property (res publica).⁴

The Dutch jurist, Hugo Grotius, wrote a text in the early seventeenth century, arguing that his nation had every right to sail to the East Indies as part of their trading venture, and that no other nation should contest this right. For Grotius, the sea was open to all - a common asset. But long gone is this *laissez-faire* view, replaced now by a growing consensus that the future health of the oceans will be dependent on an international framework of controls. It is this required framework that comprises ocean governance.

The choice for the international community on how best to use this sea is to either allow a 'free for all' between nations, or to attempt to impose at least a first semblance of order. Not surprisingly, it is the second option that is favoured: '*good order is the foundation of all good things*'.⁵ This is why the United Nations, with its global reach, has shown itself to be essential to the emergence of a more comprehensive solution.⁶ In pointing the way towards greater international responsibility, the importance of the 2030 Agenda for Sustainable Development – adopted by the General Assembly in October 2015 – cannot be over-stated.⁷ Although it does not, in itself, establish a new system of governance, it does, at least, indicate clearly the importance of the oceans in working towards the goal of a sustainable planet; and it points to what such a system is required to do.

The Agenda in question is centred on seventeen Sustainable Development Goals, the fourteenth of which is directed to conserving and ensuring sustainable use of the oceans and marine resources. In addition to this generic target, Goal 14 includes specific objectives on fundamental issues such as over-fishing, marine pollution of all kinds, and the need for measures to limit ocean acidification and the effects of climate change. Details are given of what should be achieved, progressively, in the years leading up to the Agenda's end date of 2030. Yet the only reference to governance of the oceans is contained in the final paragraph of Goal 14, in which it is suggested that the necessary measures can be achieved 'by implementing international law as reflected in the United Nations Convention of the Law of the Sea, which provides the legal framework for the conservation and sustainable use of oceans and their resources ...'⁸ This surely begs the question of whether this existing legal basis is sufficient to make the change that is required, when it has not done so previously.

The fact remains that there are flaws in the chain of governance, from international through to local. At the international level, the intentions are good, but

the powers to achieve these are insufficient. At a national level, some countries are working hard to ensure that the sea is used sustainably, whereas other countries continue to behave without due regard to desired international norms.

There is work to be done, but credit is due for what has been achieved. In the interests of good governance at least a start has been made, with an assortment of measures designed to introduce a basic level of control. These measures can be classified in geographical terms, being applied, first, to those parts of the ocean that are broadly within national jurisdictions and, second, to those which extend to the high seas beyond. Additionally, there are thematic controls directed to the regulation of designated activities.

National waters

Against this global background, the starting point for the rest of this chapter is to identify those parts of the Indian Ocean that are closest to the shores of the region's continental and island nations. In legal terms, these innermost areas include two designations, 'territorial waters' and 'exclusive economic zones' (EEZs). The authority for both is vested in what is popularly known as the Law of the Sea.⁹

Although the first attempts to create an international framework to regulate the use of the oceans date back to the 1950s, an agreement was not reached until 1994, when a sufficient number of signatories finally endorsed the proposals of a United Nations convention held in 1982. It was by no means comprehensive in its scope nor in the support it received (the United States, for instance, refused to be a signatory until 1994), but it remains the nearest the world has to common principles for the use of the sea.

At the very least, the Law of the Sea designates areas with different jurisdictions. Closest to the shoreline is the territorial sea, which may extend to a distance of up to twelve nautical miles seawards. Within these coastal waters, the sovereignty of the adjoining nation applies. The only exceptions to full sovereignty are to allow, for instance, safe passage for foreign ships, but to all intents and purposes, full control over these waters is exercised by the home nation. Additionally, up to twenty-four miles beyond the outer limit of the territorial sea, there is a 'contiguous zone' in which a sovereign state enjoys limited powers to prevent infringement of its own laws and regulations.

A second major category (beyond the territorial sea) is a much larger area, termed the 'exclusive economic zone'. Broadly, this allows the state in question to enjoy sovereign rights to conserve and use the resources of this, sometimes extensive, zone. The zone may extend for up to 200 nautical miles beyond the outer limits of territorial waters. In fact, the geography of these zones varies considerably in size, depending on the configuration of the sovereign state. Archipelagos, for

instance, where islands are widely dispersed (as in the case of the Seychelles), may give access to an EEZ that is far greater in extent than that belonging to a conventional seaboard nation.

High seas

Beyond the outer limits of the various EEZs are the high seas. Because these are not within the reach of any one national jurisdiction, and because international controls are ineffectual, they remain vulnerable to misuse. It is true that, as long ago as 1958, under the auspices of the United Nations, a Convention was held on Fishing and Conservation of the Living Resources of the High Seas. A call was made to prevent over-exploitation and this was duly agreed by the international signatories in 1966. However, the relevant section of the subsequent Law of the Sea places more emphasis on freedom of use of this vast area, rather than on ways to achieve effective conservation. As a result, the high seas are presently the weak link in the ocean governance chain, which is why attention is at last being focused on ways to introduce a degree of regulation.¹⁰

The starting point of this ongoing initiative dates from 2006, with the passing of a resolution in the UN General Assembly calling on deep-sea fishing nations to recognise their responsibilities to protect the biodiversity of one of the world's last natural frontiers (and certainly the most extensive). Ten years later, it was concluded that nations were not doing enough to achieve this goal and that further efforts were needed. It was urged that environmental impact assessments should be carried out and account should be taken of the effects of climate change and ocean acidification. Ways should also be found to reduce the adverse impact of by-catches.

In an attempt to speed up the process and to keep governments to the task, a pressure group, The High Seas Alliance, was formed in 2011, with the key objective of seeing the introduction of 'a new international legally binding treaty under the United Nations Convention on the Law of the Sea that will protect biological diversity in the high seas and seabed'.¹¹ In addition to preventing the likes of over-fishing, deep sea-bed mining and irresponsible shipping practices, a major concern of the group is to enable the establishment of marine protected areas outside the areas of national jurisdiction.

Designated uses

Over and above defined geographic areas, there are a variety of measures designed to control particular uses. Some of these, like fishing, although crucial to the future sustainability of the sea, have proved to be difficult to enforce. More recently, however, there is evidence of a greater awareness of the need for action.¹² In other cases,

progress has been made, incrementally, over a longer period. An example of the latter is in relation to international shipping. Although attention is focused on the working conditions on board ship and advanced safety standards, the regulations that control shipping also include practices to protect the marine environment. Overriding authority is vested in a United Nations agency, the International Maritime Organization, which is renowned for its strict codes of conduct and effective enforcement. As well as passing responsibility for compliance to the states where ships are registered, the many ports around the world are also given powers; for instance, port authorities may even detain a vessel in cases of non-compliance.

Another field that has attracted international interest concerns the dumping of waste materials. This featured in the original Law of the Sea, although giving responsibility for enforcement to individual nations, rather than to an international body, has reduced its effectiveness. Largely through the intervention of the United Nations, attempts have been made to control the dumping of chemicals and radioactive materials, but the widespread evidence of plastic in the sea reveals that dumping in one form or another continues to evade control by the authorities. In advance of international legislation, an increasing number of individual nations have already taken action to reduce, if not reverse, the rate of plastic pollution.¹³

Action has also been taken against piracy, not so much through legislation as by direct intervention. In the Indian Ocean, evident on a small scale from the 1990s but peaking around 2011, pirates emanating from the shores of Somalia were seriously threatening the free passage of ships in the region. By 2016, incidents had been effectively curtailed, largely through a strategy of containment by a number of national navies acting in concert. This demonstrated that, when the direct interests of any one nation are threatened, action will be taken, but it also showed that a concerted response, essential to the success of the strategy, is too often slow in coming.

Seychelles: A Small Island State in a Large Ocean

*The ocean which surrounds us is our passport to the future.*¹⁴

The Republic of Seychelles is an archipelago comprising 115 islands dispersed across a wide stretch of the western Indian Ocean. Although the combined land area amounts to no more than 455 km² (of which more than half is protected from future development), the distribution of the islands results in a very extensive EEZ. Covering nearly 1.4 million square kilometres, it is the second largest in Africa, and in size the Seychelles (including its sea) is ranked twenty-fifth in the world.

In all respects, the Seychelles is an ocean state, and it is little wonder that the sea looms large in plans for the nation's future. Quite simply, the archipelagic waters are a source of great wealth, and the belief is that their potential has barely been tapped. Tourism and fishing are the two main pillars of the economy, but neither are sure to prosper indefinitely in their current form. Ways have to be found to ensure that all activities are sustainable; indeed, sustainability is the essential point of difference from all that has gone before.

The Seychelles will, of course, benefit from a stronger international framework so that its ambition to create a Blue Economy is not undermined by the separate actions of larger nations. In the meantime, while supporting the United Nations in its slow but steady progress towards improving the means of ocean governance, recent experience suggests that early steps can be taken to promote the nation's own interests. To this end, the Seychelles has joined with other small island nations with similar concerns, so as to project a louder voice to the world community. A second step is to explore creatively what more can be done now, within the existing framework, to advance the cause of the Blue Economy.

The Voice of Small Island States

The former President, James Michel, is well regarded in the international community as one of the pioneers of the Blue Economy and as an advocate of the interests of small island states. He spoke regularly on behalf of his own nation, as well as about the many comparable nations across the world.

It is not surprising that small island nations like my own were amongst the first to call for sustainable change across the world's oceans. Our islands really are on the front line and stand to lose most unless there is a concerted approach.¹⁵

President Michel was always aware that the Seychelles, with a population of just 100 000, was unlikely to command the attention of the world's powers on its own. In the course of negotiations in the committee rooms of the United Nations and other international bodies, its voice could too easily be ignored. Likewise, there are other small island states in a similar situation. The welfare of the world's oceans is vital to them all, and yet, for geopolitical reasons, these diminutive nations struggled to be heard. It was in the interests of them all, the Seychelles included, to join forces to gain a proper hearing in international circles.

There has, in fact, since 1992, been an active network of small island states designed to promote the, too often marginalised, interests of member countries.¹⁶ In spite of their maritime locations, early priorities were directed more towards making better use of their limited land area, than to the vast potential of the

surrounding sea. With the growing interest in the Blue Economy, this balance has now shifted. A turning point became evident in 2014 with the International Year of Small Island Developing States (SIDS). Formally designated by the United Nations, the former Secretary-General, Ban Ki-moon, explained that the International Year 'is an opportunity to appreciate the extraordinary resilience and rich cultural heritage of the people of Small Island Developing States'.¹⁷

The highlight of the year was the Third International Conference of SIDS, held on the Pacific island of Samoa in September 2014. President Michel addressed the gathering with the words:

Our islands are the sentinels that protect the oceans, while they must also be the platforms for the sustainable harvest of their resources.¹⁸

Just two months after the high-profile Samoa event, ministers of small island states were invited to the Seychelles to continue the discussion. Important connections were made in relation to the impact of climate change and to the fact that the Blue Economy cannot be developed without reference to this over-riding context. As the host of that meeting, President Michel reflected that the leaders of small island states carried responsibility, as guardians of some of the world's most strategic geopolitical spaces, and custodians of vast untapped resources and unique biospheres. The Blue Economy, he asserted, was about empowering islands in a new and fundamental way:

It is about taking ownership of what is rightly yours. It is about your birth-right. It is about the inheritance of our children.¹⁹

Promoting new initiatives

At the same time as campaigning across the world for the interests of small island nations like the Seychelles, there was much that could be done at home. Even with an international framework of codes of conduct that left much to be desired, opportunities could be found to advance the cause.

To start, there was political groundwork to be undertaken. In terms of national governance, the former President had to convince his Cabinet of Ministers that the promotion of the Blue Economy needed to be on their individual agendas. One way of doing that was to create a dedicated government department, with ministerial representation at all Cabinet meetings. It is believed that the Seychelles was the first country to do this. Even after James Michel stepped down from office, in 2016, his successor, President Danny Faure, retained a separate department, this time under the direct control of the Vice-President.

Significantly, over a relatively short period, a number of important initiatives have already been taken, which are of benefit to the Seychelles, but might also serve as a model for other interested nations.²⁰ One such project is an agreement with its southern neighbour, Mauritius, to share responsibility for the conservation and development of the subterranean Mascarene Plateau that connects the two nations. Launched in 2012, the Agreement between Mauritius and the Seychelles meant that they jointly undertook to manage some 400,000 square kilometres of seabed. A strategic plan to guide their joint efforts over a three-year period was launched in January 2016. This plan, in turn, contains five key objectives, designed to strengthen the joint management body and to improve marine planning across the area of the plateau.²¹

Collaboration of this sort is unusual, but it is no coincidence that the plateau is believed to contain valuable oil and natural gas reserves. The prospect of joint development was an important incentive to agreeing to this approach. In the event, the potential for extraction of these subterranean reserves has remained at an exploratory stage, and the initiative remains, at least for the time being, effectively in abeyance. Although collaboration has not, to date, yielded tangible outcomes, there is a mechanism in place for further collaboration between the two nations when the time is right.

A second project is to convert some of the nation's capital debt into funds to support Blue Economy projects. The former President has explained that, during a visit to Paris towards the end of 2014, he met with the then French President, François Hollande, to seek ways to achieve this. The outcome of the high-level meeting was an agreement to secure the cancellation of almost \$30 million of the national debt through an innovative financial mechanism, the Debt-to-Adaptation Swap. In his State of the Nation Address, in February 2015, he announced that his proposal for a partial exchange of the national debt, in return for financing action to mitigate climate change, had been formally accepted by the Paris Club of creditors. In addition, the Seychelles was given a further 5 per cent reduction on the remaining debt. President Michel concluded:

Through this debt exchange, we shall be better able to protect our oceans, create opportunities for artisanal fishing, reduce our foreign exchange payments, and keep more money within our economy.²²

For what is widely regarded as an innovative way to make progress in protecting the oceans, credit is paid to the American and Canadian chapters of the Nature Conservancy, both of which provided guidance and financial support.²³ The Conservancy had previously brokered such agreements in different countries, but these were mainly used to raise funds for land-based projects, especially for the

protection of forests. Using the released funds for ocean conservation marked a new direction. For the Seychelles, this was to provide a unique opportunity to operate on a large scale, and a means was found to manage and make full use of the funds. Subsequently, legislation was passed to create the Seychelles Conservation and Climate Adaptation Trust (SeyCCAT). The purpose was to allow the Trust to take responsibility for both repaying interest and directing the bulk of the money to active conservation. Once the interest is repaid, a fund will be accumulated for ongoing conservation work.

In fact, the availability of this funding was to yield immediate benefits, with direct support for a third important initiative – a plan to zone a large extent of exclusive space as a marine protected area. It is intended that some parts of the designated area will be totally out of bounds for fishing and other extraction activities, whilst other zones will be used but strictly controlled. Overall, the intention is to balance the demands of development with the needs of conservation.²⁴

The Seychelles had, in fact, been active in designating a marine-protected area from as early as 1973, but the current project – to eventually zone the whole of the EEZ – is on an altogether larger scale. In particular, it will make provision for a wide variety of uses and will include a ‘no-go’ area to provide maximum protection for the marine environment. In principle, it is based on the same rationale as land-use planning.

The Seychelles Marine Spatial Planning Initiative (as it is officially termed) is a Government-led process, albeit with international support. It is described as:

... an integrated, multi-sector approach to address climate change adaptation, marine protection and support the Blue Economy and other national strategies. The process includes input from all major sectors of the Seychelles, including commercial fishing, tourism and marine charters, biodiversity conservation, renewable energy, port authority, maritime safety, and non-renewable resources in order to develop a comprehensive marine plan with stakeholder input.²⁵

The planning process was started in 2014 (before the necessary funds were secured) and the central goal is for 30 per cent of the territorial sea and EEZ to be zoned in high and medium biodiversity protection areas, with each comprising about 15 per cent of the Seychelles’ waters. Authorised uses in the various zones will be matched to biodiversity objectives and account will be taken of the sustainability of fisheries and tourism, with some areas precluded from any form of exploitation. It is the first comprehensive marine plan in the western Indian Ocean and, on completion, is expected to be the second largest in the world (the largest is in the Pacific). More significantly, it could provide a template that other nations

could later adopt for their own use. In fact, in October 2016, under the auspices of the Nairobi Convention, it was already possible to report on Mauritian and South African progress in preparing their own marine plans.²⁶

Finally, in the wake of the well-tried example of Green Bonds to fund sustainable development on land, the Seychelles has plans to introduce its own issue of Blue Bonds to support innovative projects at sea.²⁷ The scheme will offer a means of attracting private-sector funding through public-private partnership, and it is seen as a model that other small island states and coastal countries could adopt. The first issue is designed to fund improvement in the management and sustainable yield of fisheries across the Mahé Plateau, an area that is close to the main island and population centre. When the issue was announced, in January 2016, it was explained that the Seychelles Fishery Authority would be the agency to implement the issue of the bonds and to receive the proceeds. Investors were assured that, if revenues from the Mahé fishery were insufficient, repayment of the bond would be guaranteed by the Seychelles Government.

The idea of Blue Bonds is promoted by the national stock exchange, Trop-X, which is one of a growing number of exchanges around the world to support the United Nation's initiative to encourage investment in sustainable development:

Drawing on the increase in investors' appetite for sustainable bonds, the current focus of the Government of Seychelles is on 'blue bonds' as a way to fund the development of sustainable fisheries ... Fisheries are a main pillar of the Seychelles' economy and the sale of the blue bonds will be linked to a fisheries management plan. This is part of a wider initiative to address the impact of climate change by providing investment options for investors who want to show that their investment is making a difference.²⁸

Ocean governance and the region

*As new pieces of the Ocean Governance framework evolve, it is imperative to develop and maintain the interconnectedness of all levels.*²⁹

There is a world of difference between 'governance' and 'government', the former referring to the process of governing as a whole and the latter to a particular set of institutions and processes. Clearly, governance is a broader concept than government and, in some respects, it provides a necessary framework for the specific actions of government. It 'is ultimately concerned with creating the conditions for ordered rule and collective action'.³⁰ Good governance is also seen as an essential precondition for the achievement of sustainable development.³¹

In relation to the oceans, the difference between the two terms is fundamental. Quite simply, as shown in the earlier sections of this chapter, there is no comprehensive system of governance in place to conserve and develop in a sustainable way an area that amounts to the greater part of the earth's surface. Instead, there are partial controls (both geographical and functional), emanating from a combination of international initiatives and national implementation. As a result, the situation is far from satisfactory, resulting in a patchwork of good and bad practice. Extensive stretches of the world's oceans remain largely unregulated and a frontier zone where controls have yet to be put in place. Even in the coastal regions, where powers do exist, the performance of different nations varies, with some showing little interest in the long-term wellbeing of their adjacent seas.

The need for greater progress in creating a comprehensive system of ocean governance is overdue. Work must continue at an international level, especially, in gaining control of the high seas, while at the level of nations the limited examples of good practice can be spread. Additionally, it is argued in the remaining paragraphs that more attention should be paid to the region as a source of effective action. Long favoured by traditional geographers, regions are seen as parts of the earth's surface that possess common characteristics; they are places where people can feel a certain degree of identity. The argument for strengthening governance at this level is compelling. At its simplest, it offers a means to address the problems of the oceans in 'bite-sized chunks' – large enough to make sense of interconnections but small enough to be meaningful for the adjoining nations. Regional governance initiatives would not be instead of international and national measures but in addition to them.

At first glance, there is really only one ocean on planet Earth - an interconnected sea that surrounds the globe. Seen from space, it is the continuity and blueness of the planet that dominates. But in a constant search for order, names are given to different geographical areas of this liquid mass. Apart from the three largest oceans, there are smaller ones that are, in effect, offshoots of the Pacific, Atlantic and the Indian Ocean (such as the Mediterranean and Baltic, the Caribbean and the South China Sea) each of which have their own important characteristics. In a global context, each of the major oceans and their subsidiary seas can be viewed as regional entities. It follows that one should then ask to what extent these could become regional sources of governance?

In fact, around the world there is already evidence that a start has been made. For instance, Australia has initiated a discussion to seek ways to enhance the current weak governance of the world's largest ocean:

The project's overarching goal is to empower Pacific Island countries and territories to effectively manage marine and coastal resources for sustainable economic

development and food security, while maintaining productive ecosystems and biodiversity. The project will also support regional organisations and countries to move towards a more holistic, cross-sectoral approach to ocean governance.³²

Similarly, the European Union is encouraging sustainable policies for the various seas within its own geographic realm, notably, the Arctic and Baltic seas, the Black Sea and the Mediterranean, as well as that part of the Atlantic designated as the North Sea. These all have particular issues that need to be addressed.³³ Elsewhere in the Atlantic, the Caribbean is another sea where efforts are being made to create an effective framework of governance.³⁴ The Antarctic and the Southern Ocean are also of great concern. In a different part of the world, the South China Sea has emerged as an area of potential conflict - a result of China creating new islands. Without a mediating body in the region to address the situation, any issues will be resolved by power politics.

Against this global background, it can be seen that the Indian Ocean is itself a regional entity – a judgement that is largely beyond contention in physical terms, except for the fact that its southern boundary is indeterminate. It might also be argued that it is not necessarily logical that it should be named after a single country, although through common usage over a long period of time that should not impede a more unified approach. With particular reference to governance in this region, the littoral nations (through international law) are all empowered to safeguard their own waters, although (as elsewhere in the world) their ability and commitment to do so is by no means consistent. Some take their responsibilities seriously while others seek only to extract what they can, without regard for the future. This is not surprising when one notes that these nations include some, such as Australia, which are highly developed and others, like Somalia, which have for years been regarded as a failed state. Equally, there is a contrast between the potential influence of large nations, such as India, and relatively remote island states, such as Comoros.

To add to this complex pattern, the Indian Ocean also attracts users from outside the region, which are drawn by the rich fisheries and territorial aspirations. China, in particular, with its interest in trade routes and access to mineral and other resources in Africa, has a growing interest in economic and security aspects in the region. Investment in a number of key port developments in the region is an important part of China's strategy.³⁵ In contrast, small island states have formed their own global network to press their specific claims, but their actual influence in the world arena should not be over-stated - the big powers still hold the advantage.³⁶

In spite of (or perhaps because of) this fragmented and competitive context, there is a case for creating a more ordered ocean environment, in which all nations are able to benefit. The goals are ambitious, but potentially rewarding for all

parties: a zone of peace, a flourishing Blue Economy, the freedom of movement across the seas (freed from the present threat of piracy), and a sustainable future. But to work towards this, there must first be an effective means of governance.

As with the other great oceans, there is at present no single jurisdiction, although there is the Indian Ocean Rim Association (IORA).³⁷ This is a membership body that provides opportunities for dialogue between the seaboard states in the region and for those from further afield (like China) that have a shared interest. Those nations with a direct interface with the sea – the nations around the rim – total twenty-one. These are the major players in any discussion on the governance of the Indian Ocean, although the rest of the world shares an interest and a claim on its resources.

If the argument is accepted that Indian Ocean governance would benefit from a set of common goals and mechanisms to achieve them, it would make sense to look more closely at the potential of the IORA to become the source of this change. Although it is not currently constituted to perform a more interventionist role, there is no reason, in principle, why it could not be transformed. The emergence of an Indian Ocean political and executive body, with broad powers to support the type of progress that is aspired to in the United Nations' Sustainable Development Goal 14, is something that might well be addressed by IORA's present Member States.³⁸ Without this kind of initiative it is hard to see how tangible progress in the sustainable use of the sea will be achieved.

It is time for action, not words. With every day that passes, the many natural qualities of the Indian Ocean, and the potential to create a sustainable future, are further eroded. This is not in the long-term interest of any nation. The downward spiral must be reversed, with new initiatives from various quarters – scientists and entrepreneurs, investors and policy-makers; and these should be located within the framework of an Indian Ocean strategy.

A radical break with the past is called for and this might lead to the following steps:

- IORA (in its existing form) to encourage all of its member states to produce their own national strategies to show how their respective EEZs could be used more productively as well as sustainably;
- in preparing their strategies, account to be taken of a list of priorities for urgent action, highlighted by IORA. For instance, the dumping of land-based waste should be phased out well before the end date of 2030 as an essential contribution to the achievement of Sustainable Development Goal 14;
- IORA to transition into a body with power to prevent the contravention of good practice and with a geographical remit that includes governance of the high seas; and

- this new body to bring together the various national plans and, combined with a plan for the high seas, embody these in a single strategy for the whole of the Indian Ocean.

All of this may require national sacrifice – relinquishing power for the greater good – as well as gain. But until something along these lines is done, the very notion of a just and effective system of Indian Ocean governance will remain illusory and the full potential of the Blue Economy will be unattainable.

A glimpse of the future

*While many countries, companies, and even the United Nations have written rules and laws, those laws are often weak.*³⁹

Reflecting on past experience is often the best way to think about the future. In spite of progress in some aspects of ocean governance, it remains piecemeal, and the methods used are frequently ineffectual. Unless the system, as a whole, is strengthened, further degradation of the sea is inevitable. However, if effective improvements were introduced without undue delay, there is still an opportunity to achieve sustainability. Based on the arguments made above, it is concluded that there are three priority areas for urgent action: the introduction of effective measures for the High Seas, greater ability to enforce international law, and the creation of a regional framework of governance.

Albeit articulated in a whimsical piece, there is truth in the suggestion that ‘basically the open sea is the new Wild West’.⁴⁰ The high seas remain a largely uncontrolled frontier and, even with ongoing efforts by the United Nations to introduce legal restraints, it is unlikely that these alone will be enough. The lure of illegal ventures leading to profits or territorial supremacy outweighs attempts to uphold the law. Laudable objectives like Sustainable Goal 14 and legislation on paper represent a start, but these must be matched by action at sea.

Enforcement of the law is critical to future success. Apart from a need for international cooperation, there is increasing scope for the application of new technologies. In fact, the opportunities offered by enforcement technologies may prove the salvation for vast tracts of the ocean. Satellite imagery is one possibility, as is electronic tracking of shipping coupled with inspection on landing. Currently, most illicit activities pass unseen and, in any case, enforcement action is limited by the flag of the offending vessel, making it difficult for other nations to intervene. In contrast, with comprehensive legislation and the latest in tracking facilities, this situation could change rapidly.

Finally, as the example of the Indian Ocean illustrates, the idea of a regional framework of governance is certainly worth pursuing. Not only would this assist with the protection of national waters, but it could be extended to the high seas too. It would bridge the gap between the international level of the United Nations and that of individual states, and between distant authority and local allegiances.

As experience on land has shown, the world's resources are too precious to be left to chance. Control of development is essential. Likewise, difficult though it will be to achieve, something akin to the measures adopted by the international community to respond to climate change are what is now needed for the ocean.

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- 8 *Ibid.*
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- 10 See, for instance, Blaustein, R., 2016. United Nations seeks to protect high-seas biodiversity. 9 September 2016. Available at: <http://highseasalliance.org/content/united-nations-seeks-protect-high-seas-biodiversity> [Accessed 30 December 2016]. In this report, he looks towards 'a supplemental biodiversity treaty to the 1982 United Nations (UN) Convention on the Law of the Sea [that] may provide an opening for protecting species and habitats in this critical area. A 2015 UN General Assembly

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IORA's Policy Framework on the Blue Economy

Shamimtaz B. Sadally

Introduction: Importance of the Blue Economy

The oceans present an important opportunity for development that could yield significant economic and social benefits for coastal nations by providing them with a wide range of resources and services while protecting environmental integrity. These include fisheries, minerals, oil and gas, rare earth metals, renewable energy, climate regulation, cancer-curing medicines, genetic resources, carbon storage, cultural value, and sustainable livelihoods and other living and non-living resources, which serve to improve livelihood, achieve holistic growth, empower native coastal communities and attain greater social and economic inclusion.

Indeed, the Blue Economy is of great importance for coastal nations, especially for developing countries, least developed countries (LDCs) and small island developing states (SIDS) as it presents great development and business opportunities that could contribute to boosting countries' economies, while maintaining a healthy balance between resource use and its renewability. Despite the crucial role of the Blue Economy and the excellent opportunities it provides countries for economic growth, a large portion of marine resources remain untapped or unexplored worldwide, as a result of various factors, including, *inter alia*: lack of human and technical capacity, lack of resources, and limited technologies. However, the main challenge remains to ensure a balance between the goal of high economic growth and environmental sustainability.

The oceans and coasts nonetheless face the challenges of increasing degradation, overexploitation and depletion of ocean resources, habitat destruction, marine pollution, rising population and the effects of climate change. These in turn compromise the ability of oceans to sustain the provision of essential resources and critically important services. The Blue Economy concept would partly contribute

to reversing the current trend of continuous degradation of marine ecosystems and functionalities.¹ This could be done through various means and, in the Indian Ocean Rim Association (IORA) context, these could be addressed through, for example: capacity building, human resource development, and research and development.

This Chapter discusses Blue Economy development in the Indian Ocean Rim Association (IORA),² including past, current and future Blue Economy activities. The first part of the chapter provides an overview of the status of the Blue Economy sectors in IORA, namely, fisheries and aquaculture, seaport and shipping, renewable ocean energy, and offshore hydrocarbons and seabed minerals. This chapter also identifies strengths, weaknesses and capacities with a view to exploring sustainable innovative solutions to address emerging Blue Economy issues.

Blue Economy development in the Indian Ocean Rim region

The Indian Ocean Rim Association (IORA) is an intergovernmental organisation comprising 21 Member States and seven Dialogue Partners, with its Headquarters (the IORA Secretariat) based in Mauritius. Its primary objective is to facilitate trade and investment and promote sustainable economic cooperation through capacity building for the development of its Member States, in its priority sectors.³

At the Eleventh Council of Ministers meeting, in Bengaluru, India,⁴ six priority areas were identified with a view to promoting the sustained growth and balanced development of the region and the Member States, and to establishing common ground for regional economic cooperation. These priority areas are:

- (i) Maritime Safety and Security;
- (ii) Trade and Investment Facilitation;
- (iii) Fisheries Management;
- (iv) Disaster Risk Management;
- (v) Academic, Science and Technology; and
- (vi) Tourism and Cultural Exchanges.

In addition, IORA has two special focus areas, namely Blue Economy and Women's Economic Empowerment.

IORA has two specialised agencies: (i) the Fisheries Support Unit (FSU),⁵ which promotes research and development, as well as capacity building in the fisheries management sector; (ii) the Regional Centre for Science and Technology Transfer (RCSTT),⁶ which focuses on various fields, such as desalination and medicinal plants, while promoting technology transfer among the IORA Member States.

The Blue Economy sector is gaining increasing importance in IORA.⁷ In fact, most Member States of the IORA are focusing their economic priorities on the ocean and have included the Blue Economy in their national strategies. With the considerable attention focused on Blue Growth, IORA has hosted two ministerial Blue Economy Conferences, each leading to the adoption of a Blue Economy Declaration.⁸ These Declarations seek to harness ocean resources in a sustainable manner and to guide Member States in ensuring the foundations for the social, environmental and economic sustainability of the ocean.

The status of the Blue Economy in IORA Member States differs according to specific ecological, geographical, and political circumstances as well as according to the technological and human expertise available in the Member States. Although the contribution of the Blue Economy to the GDP of IORA Member States is increasing, data on this sector is limited. Countries have achieved different levels of Blue Economy development with different priorities, technologies and resources. In addition, the different sectors of the Blue Economy are handled by different Ministries making access to data collection and analysis difficult.

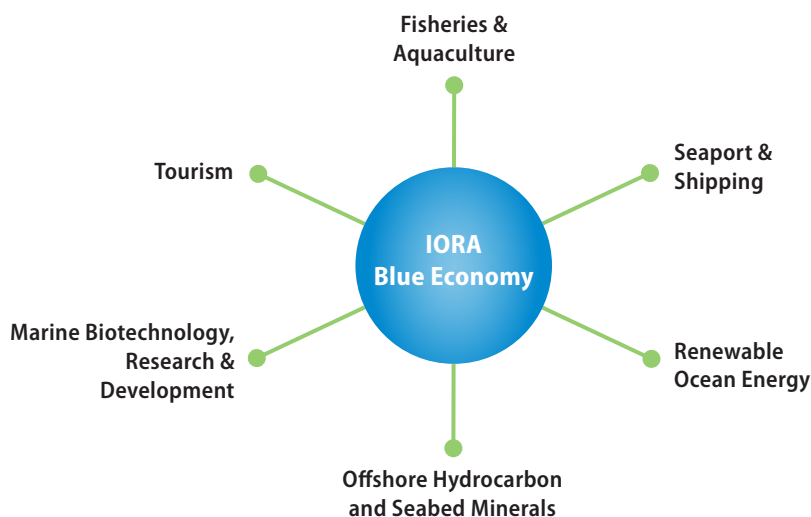
Indeed, oceanographic, geological, geochemical and geophysical data are critical to a better understanding of marine ecosystems, processes and resources. Marine data collection, analysis, compilation and sharing are being encouraged among IORA Member States to ensure improved management of the ocean's resources and the sustainable development of the Blue Economy. Some Member States are now paying more attention to the collection of scientific data and are, for example, involved in and participating in the Second International Indian Ocean Expedition (IIOE-2) aimed at collecting data on a range of physical, biogeochemical, biological and climatic characteristics of the Indian Ocean, as well as at sharing the various initiatives that are being conducted by countries in the Indian Ocean region.

The importance of data collection has also been highlighted at various IORA events and several initiatives have already been taken forward to address this issue, as well as build capacity of IORA Member States. For example, a training course on Ocean Research Data Management was held in Kuala Terengganu, Malaysia from 22 to 26 May 2016,⁹ to build the capacity of Member States in terms of research data management. Building on this initiative, IORA will be working closely with its Member States to assist them in improving their capacity and skills in data management, and ultimately the sustainable development of their country's Blue Economy.

IORA Blue Economy priority sectors

At the Fourteenth IORA Ministerial Meeting in Perth, Australia, in October 2014, the Australian Foreign Minister, the Honourable Julie Bishop, introduced the Blue Economy theme.¹⁰ As a result, the IORA Secretariat, in consultation with Member States, has identified six focus areas (Figure 9.1) in the Blue Economy, with Ocean Knowledge Clusters.

Figure 9.1: *IORA Blue Economy Priority Sectors*



Source: Diagram by Author

Capacity of member states in the Blue Economy

With a view to analysing the status and assessing the needs of Member States in different areas of the Blue Economy, the Secretariat has compiled information on four focus areas, namely: Fisheries and Aquaculture; Renewable Ocean Energy; Seaport and Shipping; and Offshore Hydrocarbons and Seabed Minerals, mainly from online sources. The analysis took into consideration several factors, including *inter alia* regulatory framework (e.g. Laws, Policies, Agreement), research and development, technical support, human resource development and capacity building (for example training, education, institutional development and organisational development), business entrepreneurship, centres of excellence, marine conservation, capacity to contribute to other Member States, Blue Economy needs, developmental prospects, and strength and weaknesses. The information collected

showed that the levels of Blue Economy development in Member States are variable and fall under the responsibility of different Ministries and/or departments.

The next section describes the current status and development of the above four focus areas in terms of regulatory framework, research and development and human resource development and capacity building.

Fisheries and aquaculture

Fisheries represent one of the main resources of the Indian Ocean, providing food to hundreds of millions of people, and contributing significantly to the livelihoods of coastal communities. While the fisheries sector plays an important role in contributing to food security, poverty alleviation and job creation, it also presents huge business opportunities. However, it has been estimated that only 47 per cent of 441 stocks are fully exploited and that: 18 per cent are over-exploited; nine per cent are depleted; and one per cent are recovering.¹¹ The total supply of seafood increased from 69 million tonnes in 1976 to 142 million tonnes in 2008.¹² Aquaculture has also made a significant contribution to the sector: in 2006, it accounted for up to 41.8 per cent of the total seafood supply, with a production output of 66.7 million tonnes.¹³ To ensure sustainability and proper management of this growing industry, IORA Member States should focus their attention on regulatory frameworks, research and development and human resource development.

In IORA Member States, fisheries and aquaculture development falls under the responsibility of respective line Ministries and relevant departments, for example: in South Africa and Australia, fisheries and aquaculture development is the responsibility of the Department of Agriculture, Fisheries and Forestry (DAFF); in India, the Division of Fisheries of the Department of Animal Husbandry, Dairying, and Fisheries of the Ministry of Agriculture is responsible for planning, monitoring and funding several centrally sponsored development schemes that are related to fisheries and aquaculture; the Aquaculture Centre in Oman undertakes scientific research with regard to marine and freshwater aquaculture; in Tanzania, both the government and the private sectors provide support by creating awareness on the rational utilisation of resources. This is done through capacity building programmes such as seminars, workshops, sectoral meetings and informal training in the private sector, focusing on key issues such as fisheries resource utilisation.

Regulatory framework

According to the IORA Code of Conduct for Responsible Fisheries (Article 9), 'States should establish, maintain and develop an appropriate legal and administrative

framework, which facilitates the development of responsible aquaculture'.¹⁴ Only a sound regulatory framework that is managed by stable institutions will ensure aquatic ecosystems. In fact, in order to achieve sustainable aquaculture development, national policies and procedures need to be identified. In addition, the implementation of a sound legal framework is required to ensure the rights of aquaculture farmers and to protect the interests of the state.¹⁵

An analysis of the information collected on the regulatory framework governing Blue Economy activities showed that IORA Member States have different legal regimes and legal institutions. This is a result of their differing levels of economic development and priorities in the Blue Economy sectors, although fisheries and aquaculture are a priority for most IORA Member States. Indeed, over recent years growing attention has been paid to the role of law and legal institutions in fisheries and aquaculture development.¹⁶ The review that was conducted by the IORA Secretariat showed that almost all IORA Member States have fisheries and aquaculture activities and some form of legal framework for their sustainable management. However, some IORA Member States have more defined and specific laws, regulations and policies covering various aspects of the fisheries sector. For example, Australia has a regulatory framework covering a wide range of areas including but not limited to marine farming planning, aquaculture, environment protection and biodiversity conservation, and marine parks.

Most developed and developing IORA Member States have a strong legal regime, but there are exceptions and some States lag behind and have no proper regulations that govern the sustainable development of the fisheries and aquaculture sector. The regulatory framework governing fisheries and aquaculture in some LDCs and developing countries are still in an infancy stage. This necessitates the support and collaboration of other developed and experienced Member States, as well as international and regional organisations, to initiate development in this important sector, which is made up primarily of artisanal fisheries, and small-scale aquaculture activities.

Research and development

In IORA Member States, research and development in the Blue Economy is recognised as an important tool towards exploring and addressing Blue Economy challenges, and various institutions are currently actively involved. Some of these institutions include *inter alia*: the Commonwealth Scientific and Industrial research Organization (CSIRO) in Australia, the Fisheries Research and Development Corporation (FRDC) and the Australian Institute of Marine Science (AIMS), the Bangladesh Fisheries Research Institute, the Indian Council of Agricultural Research (ICAR), the Agency for Marine and Fisheries Research Affairs, the Agency

for the Study and Assessment of Technology (BPPT) in Indonesia, the Indonesian Science Institute (LIPI), and the Iranian Fisheries Research Organisation (IFRO). In addition, there are several centres and institutes that carry out research activities related to fisheries, including Freshwater Fisheries Research Institutes/Centres/Stations, Coastal Fisheries Research and Aquatic Animal Genetics Research and Development Institutes/Centres/Stations. The Marine Environment Research Centre (MERC) in UAE and the Aquaculture Research Centre (ARC) in Yemen are also involved in fisheries research.

However, despite the advancement of research and development in the region, some developing and least developed Member States still have no facilities for fisheries and aquaculture research and require the assistance of other countries, as well as IORA Dialogue Partners.

Human resource development and capacity building

Capacity building, human resource and skills development are considered an important tool for enriching knowledge, expertise and skills in specific fields. IORA Member States have highlighted the importance of capacity building under each priority sector for improving performance and achieving developmental objectives. In order to promote capacity building, Member States have ensured there are several institutions and universities that offer training programmes that cover a wide range of topics relating to the Blue Economy. These include, for example, the Australian Maritime and Fisheries Academy, the Australian Fisheries Economics Network, the Indigenous Aquaculture Unit (IAU); the Central Institute of Fisheries Education and the College of Fishery Science in India; the Iran training and extension centres affiliated with the Iranian Fisheries Organization; Moi and Nairobi universities in Kenya; the Fisheries Training and Extension Centre (FiTEC) at the University of Mauritius; the Fishermen's Training Institute in Al-Khaboura in the AlBatina Region in Oman; universities in South Africa; and universities in Thailand. However, although almost all IORA Member States have training institutions, universities and/or centres to enhance capacity building in their respective countries, not all of them have such facilities and resources and their aquaculture and human resource development and capacity building remain limited.

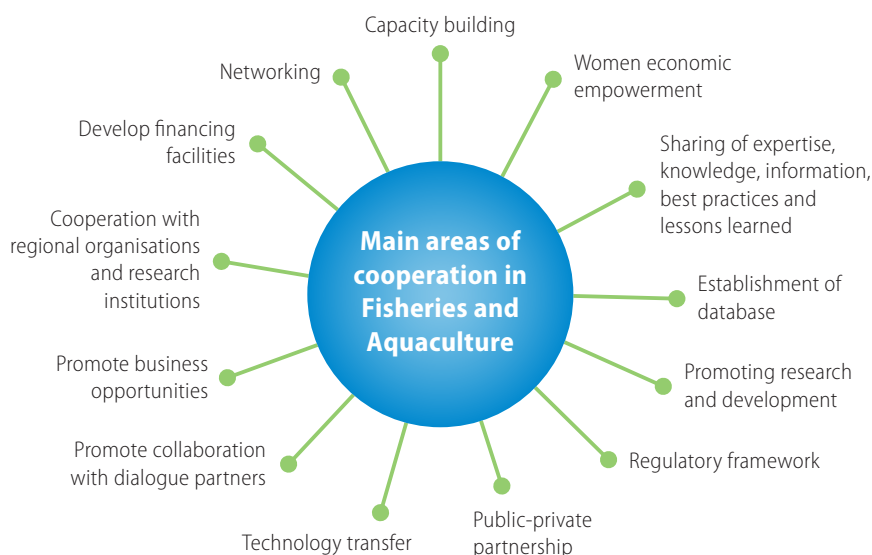
Fisheries and aquaculture related events in IORA

Several events related to the fisheries and aquaculture sector and which address various issues were carried out from 2015 to date, including:

- IORA Blue Economy Core Group Workshop on “Promoting Fisheries & Aquaculture and Maritime Safety & Security Cooperation in Indian Ocean region”, 4-5 May 2015, Durban, South Africa;
- First IORA Ministerial Blue Economy Conference, 2-3 September 2015, Mauritius;
- IORA Trainer’s training programme on marine aquaculture, 2-3 May 2016, Antananarivo, Madagascar;
- IORA Training programme on ‘seafood handling, post-harvest processing and storage of fisheries and aquaculture products’, 1-2 September 2016, Comoros;
- Workshop on a Seafood Products Safety and Quality, IORA Fisheries Support Unit, 6-10 November 2016, Oman; and
- Second Ministerial Blue Economy Conference on ‘Financing Blue Economy’, 8-10 May 2017, Indonesia.

Subsequent to these events, Member States made several recommendations on specific issues. Figure 9.2 summarises the main areas of future cooperation proposed by Member States in the fisheries and aquaculture sector.

Figure 9.2: Summary of the main areas of cooperation in the fisheries and aquaculture sector as proposed by IORA Member States



Source: Compiled by Author

Under each area of cooperation, Member States suggested focusing on a wide range of topics as summarised in Table 9.1.

Table 9.1: *Summary of outcomes from IORA fisheries and aquaculture related events from 2015 to July 2017*

Areas of future cooperation for follow-up actions	Specific topics
Capacity building	■ Fishing techniques, marketing and export of fish ■ Hatcheries and aquaculture systems ■ Food safety and quality of aquaculture products ■ Harvesting, processing and storage of aquaculture-based products ■ Value addition of by-catch products
Sharing of expertise, knowledge, information, best practices and lessons learned	■ Failure and success stories on aquaculture development ■ Water quality management, including legislation and regulatory frameworks in aquaculture systems ■ Measures adopted and existing online services for reporting cases of disease outbreak ■ Existing quality assurance regulation, safety standards and certification systems ■ Marine conservation and management, climate change impacts and mitigation, and socio-economic factors on marine resources near aquaculture sites in the IOR region ■ Hatcheries management ■ Maritime Safety and Security issues among Maritime Security agencies ■ Sustainable fishing practices, including Illegal Unreported and Unregulated (IUU) fishing ■ Seafood handling, post-harvest processing and handling of seafood products and how to improve this sector using simple, environment-friendly and renewable energy technologies to improve ■ Member States' laboratory capacities ■ Sustainable by-products/waste management ■ Current bio-preservation methods ■ Natural means for controlling the shelf-life and safety of food products ■ Biological agents being used in IORA Member States
Promoting research and development	■ Sustainable aquaculture feed production ■ Alternative ingredients to fish meal to promote sustainable aquaculture activities ■ Spatial planning tools to support ecosystem approach for sustainable aquaculture development ■ Monitoring and environmental assessment techniques ■ Reducing environmental impacts ■ Environmentally friendly aquaculture activities such as cultivation of seaweed ■ Potential use of seafood by-products/waste

Promoting research and development (cont.)	■ Sustainable management of waste water in the seafood processing operations ■ Methods to extend the duration of preservation in a safe and cost-effective manner ■ Improving appliances and the effectiveness of traditional techniques of bio-preservation ■ Maximising the use and to explore the potential applications of low-value fish products and seafood waste
Regulatory framework	■ Developing more fishing agreements bilaterally and sub-regionally to harness cooperative efforts and develop sustainable fisheries management ■ Improving the safety and quality of fish and fish products through improved guidelines ■ Boosting investor interest in developing a sustainable aquaculture sector
Establishment of database	■ Maritime Safety and Security by compiling existing information through a desktop exercise ■ Experts, expertise and institutions in the Indian Ocean Region ■ Regional laboratories and experts dealing with diseases; common pathogens; and aquaculture associated diseases, in the IOR region.

Source: Table compiled by the Author

Renewable ocean energy

The world's population is expected to increase to an estimated nine billion people by 2050, which is 1.5 times greater than the current population; this will result in an increase in demands for fossil fuel. It was reported that as many as two billion people worldwide do not have access to electricity, and with the rapid rise in population numbers, electricity demand will increase.¹⁷ However, the rising and continuous combustion of fossil carbon has contributed to increased levels of greenhouse gases, thus contributing to global warming and climate change. In fact, the energy sector generates 65 per cent of greenhouse gases emissions,¹⁸ which is expected to further increase with the development of emerging economies resulting in more environmental degradation. These phenomena are expected to threaten ecological stability, food security as well as social welfare and necessitate the substitution of the declining fossil fuel stock by a more environment-friendly and sustainable renewable energy source.

The energy sectors in the Indian Ocean Rim Member States are also experiencing major challenges owing to their vulnerability to climate change and the rising prices of imported fuels, which have an impact on the economy and thus on the population as a whole. Given that the Member States are highly dependent on

imported fossil fuel, alternative sustainable and renewable energy production may reduce this dependency and provide greater environmental and security benefits. Countries of the Indian Ocean have tremendous potential for developing renewable energies, and the time has come to explore the possibilities of deriving energy from the ocean. Six sources have been identified: wave energy, tidal range, tidal currents, ocean currents, ocean thermal energy conversion (OTEC), and salinity gradients, each having different origins and requiring different technologies for energy conversion. However, if the potential for ocean energy production is to be fulfilled, the many technical, economic, social and infrastructural imbalances across the Region will have to be resolved.¹⁹

Regulatory framework

Despite the increasing need to shift to more sustainable and clean energy sources, most IORA countries have limited policy incentives for renewable ocean energy and it has received little attention. A regulatory framework on renewable ocean energy is essential if the sector and its business opportunities are to grow. It is useful to consider the example set by some Member States. In Australia, the Australian Navy Defence Support Group entered into a Memorandum of Understanding (MOU) with Carnegie Wave Energy in 2008, in order to carry out an initial feasibility assessment of the potential for wave power generation off the west coast of Garden Island. The National Energy Council of Indonesia (NEC) is advocating the development of ocean energy through its National Energy Policy. In South Africa, the Department of Energy of South Africa and the 2008 National Energy Act govern the development of renewable energy sectors, with ocean energy being one of the renewable energy sources targeted. Other IORA Member States still lack access to comprehensive, accurate and reliable information on renewable ocean energy.

Research and development

Research and development into renewable ocean energy is a pre-condition for any comprehensive and responsible energy plan and for the development of guidelines for the protection of the marine environment. Increasing concern over the threat of climate change has resulted in an increased interest in renewable energy technologies, and research on renewable ocean energy sources is contributing to the development of promising new technologies. These technologies provide commercial opportunities, but it is extremely important that the development of new ocean energy technologies does not disturb the marine environment, which is already suffering from the effects of, for example, over-fishing, pollution, habitat loss and climate change.²⁰

IORA Member States are therefore giving high priority to renewable ocean energy research, in order to benefit from commercial opportunities. IORA institutions carrying out such research are, *inter alia*, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Australia; universities, such as the University of Tasmania, the Australian Maritime College, the University of Wollongong, the University of New South Wales, the Water Research Laboratory, and the University of Sydney; and the National Institute of Ocean Technology (NIOT) in India.

The Australian Renewable Energy Agency (ARENA) has allocated \$13.1 million to the US\$40 million project on wave energy.²¹ Bangladesh has also identified the development of renewable energy as a programme of the Bangladesh Climate Change Strategy. NIOT in India is currently undertaking research to develop technologies for tapping renewable energies and generating fresh water from the ocean, as well as conducting research on marine turbines for the production of electricity. Research and development, publication and applications using ocean energy are being carried out by the Indonesian Ocean Energy Association (INOC-EAN). In South Africa, the Centre for Renewable and Sustainable Energy Studies at Stellenbosch University has a number of facilities that are used for renewable ocean energy research. Similarly, a number of renewable ocean energy studies are currently underway in Malaysia, aimed at using ocean thermal energy conversion (OTEC) as a primary source of renewable ocean energy. Malaysia recently rolled out a plan involving the National Oceanography Directorate (NOD) and the establishment of a National Oceanography Committee to act as the Focal Point for research in the maritime sector and all oceanographic-related activities in Malaysian waters. The aim is also to facilitate implementation of national and intergovernmental programme on marine science and oceanographic research and development.

Although many countries are moving towards developing more renewable ocean energy sources, some countries have limited technology, resources, investment facilities and capacity. Notwithstanding this situation, new initiatives are being launched to support the development of this sector. For example, Sri Lanka is promoting research, development and use of new and emerging technologies and practices, especially the use of non-conventional renewable energy, to suit the Sri Lankan context. Several renewable ocean energy opportunities are being explored by the Mauritian authorities. Preliminary research on Mauritius and Rodrigues has shown that the region has strong potential to develop its Ocean Thermal Energy Conversion (OTEC) sub-sector, that is, energy production from waves, currents and wind. The focus of some of the IORA countries is on renewable energy, but with no emphasis on energy sources derived from the ocean. In addition, although the International Renewable Energy Agency (IRENA) in the United Arab Emirates has been working to promote renewable energy sources, little has been done in the

renewable ocean energy sector. There therefore is a need to enhance cooperation in developing this sector in the Indian Ocean Rim Region.

Human resource development and capacity building

Data on human resource development and capacity building in relation to renewable ocean energy are available in respect of only a few countries. Several universities from Australia and Indonesia are focusing on these areas. In Indonesia, the government supports technical capacity-building, resource assessments, and trade promotion. These initiatives are spurring on the development of the geothermal sector. In India, the College of Energy, Environment and Sustainability offers courses on multiple renewable energy sources including renewable ocean energy. Similarly, the Indian Institute of Technology, Madras Department of Ocean Engineering possesses several laboratories for ocean research. In South Africa, Stellenbosch University has the Centre for Renewable and Sustainable Energy Studies, which offers several course modules on sustainable development, renewable energy systems, renewable energy finance, thermal energy systems as well as ocean energy and hydro power.

Seaports and shipping

By virtue of its geo-strategic location, i.e. being bounded by three continents (Africa, Asia and Australia), as well as the Middle-East region, the Indian Ocean holds immense economic significance in the context of the global economy, primarily in terms of the shipping industry. Effectively, 'half' of the world's container ships, one-third of the bulk cargo traffic and two-thirds of the world's oil shipments converge in the region, strengthening the importance of the Indian Ocean as a central strategic scene in the 21st century'.²² Because of the pivotal role of the shipping industry, ports and logistics have a significant role to play with regard to the rapid growth of maritime trade and commerce among IORA Member States.

Although shipping in the region continues to grow, the distribution of trade across the Rim countries is uneven and few IORA countries are able to maintain their trade and investment activities and derive economic benefits from maritime exchanges and transportation. Most Member States struggle to keep pace with the rapid development and complexity of maritime trade and face a wide range of challenges, such as congestion and the need for new information technology development and equipment, improved port infrastructure and better professional shipping services. In this regard, regional cooperation remains an important strategy to unlocking the bottlenecks in the shipping and port industry and enhancing economic cooperation and trade relations among Member States.

Seaports and shipping are particularly important to IORA Member States as they are all coastal countries. IORA has historically enshrined trade and business facilitation among its priority areas of which seaports and shipping are significant components. It is for this reason that IORA has identified seaports and shipping in the Indian Ocean as a priority area of the Blue Economy. To develop this sector, IORA has been focusing on ways to improve maritime connectivity, ship registration, as well as enhance capacities in sustainable port management and services. IORA therefore hosted a training programme entitled on 'Enhancing Sustainable Port Services and Management in the Indian Ocean region for improved Maritime Connectivity', in Mutsumudu, Anjouan Island, Comoros, from 12 to 14 July 2017.

Regulatory framework

The International Maritime Organisation (IMO) is the United Nations agency that regulates the shipping industry and which is responsible for the safety of life at sea and the protection of the marine environment.²³ The labour standards, which are applicable to seafarers worldwide, fall under the responsibility of the International Labour Organization (ILO). In view of its responsibility of governing ships and protecting the marine environment, the IMO has implemented a comprehensive framework of detailed technical regulations, in the form of international diplomatic conventions. National governments that are members of the IMO have to implement and enforce these international rules, and make sure that ships registered under their national flags conform to these rules.²⁴

In IORA, the regulating body governing seaport and shipping varies with the Member State. For example, the regulation and safety oversight of Australia's shipping fleet and the management of Australia's international maritime obligations fall under the Australian Maritime Safety Authority (AMSA). The Comoros Merchant Shipping Act 2000 governs all administrative activities and registration procedures.²⁵ Indian ports are also generally administered and regulated by the Central and State Government. The Ministry of Shipping is responsible for formulating policies and programmes on shipping and the ports sectors and for their implementation.²⁶ Cabotage restrictions have been implemented by the Indonesian Government, and the introduction of the Maritime Law No 17 of 2008, which aims at providing business opportunities and greater market share to Indonesian companies, has contributed to major changes in Indonesia's shipping and offshore marine industry.²⁷ This initiative has been followed by further new regulations to the Shipping Act in Indonesia, aimed at regulating a wide range of transportation aspects.²⁸

The Islamic Republic of Iran's Ministry of Roads and Transportation Ports and Shipping Organisation (controlled by the Islamic Revolutionary Guard Corps (IRGC)) is the regulatory body in Iran, which has various laws governing the

sector. The Merchant Shipping Regulation in Kenya (2011), established by the Kenya Maritime Authority, allows for detention of vessels or suspension of services until compliance standards are met. The 1988 Convention for the Suppression of Unlawful Acts of Violence against the Safety of Maritime Navigation in Madagascar is applicable in the context of maritime piracy and armed robbery at sea. In Mauritius, the Mauritius Merchant Shipping Act 1986 and the Mauritius Shipping (Amendment) Act 1992, largely modelled on the British Merchant Shipping Act, regulate ship registration and mortgaging.²⁹

Research and development

IORA Member States recognise the importance of research and development in the seaport and shipping field. However, levels of development in the Member States differ, with some countries still lagging behind, as a result of limited resources, technology and capacity. Nonetheless, many initiatives have been undertaken by IORA Member States. For example, in Comoros, the European Development Fund (EDF) Comoros National Authorising Officer (CAON) Support Unit has assigned the Maritime and Transport Business Solutions of the Netherlands to develop a national port project for the ports on the Comoros Islands. In Kenya, a new berth was constructed at the Mombasa seaport in 2013, in order to increase port facilities and cargo space. In Madagascar, the main purpose of the Port Rehabilitation Project is to rehabilitate the physical infrastructure and equipment of 10 ports.

The Port Victoria harbour in the Seychelles is another example of development in the sector. This is a two hundred million US dollar project to maintain Port Victoria's position as the region's pre-eminent fisheries hub and fuel bunkering point. This project will also enable Port Victoria to realise its potential as a container transshipment point serving the western Indian Ocean and east African seaboard. Meanwhile in Somalia, the first stage of the port of Bosaso will offer accommodation for one general cargo vessel and 350 metres of quays for small cargo vessels and fishing boats. The Tanzania Ports Authority (TPA) also plans to improve the performance of Dar es Salaam and increase annual cargo traffic by 30 per cent.³⁰ Moreover, considering the growth in the shipping industry in UAE, the UAE-based Hamriyah Free Zone Authority (HFZA), Sharjah, is setting up a new maritime city for marine and maritime-related industries.

Despite the fact that some IORA Member States, especially the developed countries, are in an advanced stage of development and have access to the latest technologies, levels of cooperation between these countries and those with less developed ports is still low. Member States have highlighted the need to promote technology transfer at various IORA events, and have requested the assistance of developed countries to:

- share experiences, information and best practice;
- ensure proper project preparation, in order to access funds for infrastructure financing; and
- find areas in which technology can be shared for mutual development.

Member States have also stressed the need to enhance public-private partnership and involve the business sector in order to promote investment and financing in various sectors of the Blue Economy, including the seaport and shipping sector. It has also been recommended that IORA academic institutions carry out research in areas of the Blue Economy which are socially relevant, such as research on the impact of development projects on local communities, that may lose land allocated for industrial and port development, especially in small island states. The importance of continued research on innovation and conservation in relation to Blue Economy objectives of Member States and of the UN Sustainable Development Goals remains firmly on the s IORA agenda for sustainable development of the seaport sector.

Human resource development and capacity building

The importance of developing the seaport and shipping sector, and thereby, boosting trade in the region, means that it is essential to build the capacities of the officials who are required to manage this emerging sector. Various organisations/institutions in Member States are carrying out capacity building programmes in the Indian Ocean Rim: the Australian Maritime College (AMC), comprising the National Centre for Maritime Engineering and Hydrodynamics and the National Centre for Ports and Shipping; the Bangladesh Maritime Training Institute (BMTI); the Indian Institute of Ports Management; the Bandari College in Kenya; the Sultanate of Oman Bursary Scheme; the Singapore Maritime Academy, the Singapore Cooperation Programme and the Singapore Shipping Association; the South Africa Maritime School and Transport College, and the School of Shipping; the Mahapola Ports and Maritime Academy, the leading marine training institution in Sri Lanka; Abu Dhabi Ports Company (ADPC) and its Ports Training Centre; and the Maritime Training Centre (MTC) In Yemen.

Seaport and shipping related events in IORA

IORA has a mandate to enhance regional cooperation, including enhancing cooperation in terms of the development of port areas in the region. The First Ministerial Blue Economy Conference (BEC-I)³¹ included a session devoted to seaports and shipping, which provided the first opportunity and platform for a discussion

on this sector. Member States made the following recommendations on the way forward for developing the seaport and shipping sector:

- Consider measures to improve ship registration in the Indian Ocean Region;
- Promote cooperation in the seaport and shipping sector in the Indian Ocean Region, including cooperation in the area of ship building, seaport logistics, among other potential areas of cooperation;
- Enhance capacity building programmes on seaport and shipping sectors in the Indian Ocean region;
- Promote cruise tourism in the Indian Ocean region; and
- Promote seaports connectivity and coastal shipping in the Indian Ocean Region.

The Mauritius Declaration on the Blue Economy (Annex 1) recognises the importance of the seaport and shipping sector in promoting trade, investment and maritime connectivity in the Indian Ocean region. Following BEC-I and in order to strengthen cooperation in this sector, China, as one of IORA's Dialogue Partners, together with the Republic of South Africa's Human Sciences Research Council (HSRC), co-hosted the Second IORA Blue Economy Core Group Workshop on Maritime Connectivity and Financing for Development in the Indian Ocean Rim, on 13 to 14 July 2016 in Qingdao City, People's Republic of China. Member States made several recommendations for the future development of this sector in IORA, including focusing on special economic zones (SEZs). Given IORA's focus on tangible projects, training programmes are being organised with a view to enhancing capacities and knowledge in port related areas.

In 2016, the Global Maritime and Port Services Pty Ltd, through the Singapore Cooperation Programme, organised a training programme on Port Management and Operations in Singapore, which saw the participation of government officials from IORA Member States. The training programme included topics such as Singapore's port management experience; international trade and transport; the management and operations of a port; future challenges to ports; and human resource development. Moreover, the training programme on 'Enhancing Sustainable Port Services and Management in the Indian Ocean region for improved Maritime Connectivity', was held in Mutsumudu - Anjouan Island, Comoros, from 12 to 14 July 2017. The training covered various modules including Sustainable Port Management Tools; Commercial Management of the Port; Port Strategic Planning and Management; and Work Practices, Security and Environmental Protection for Sustainable Port Management.

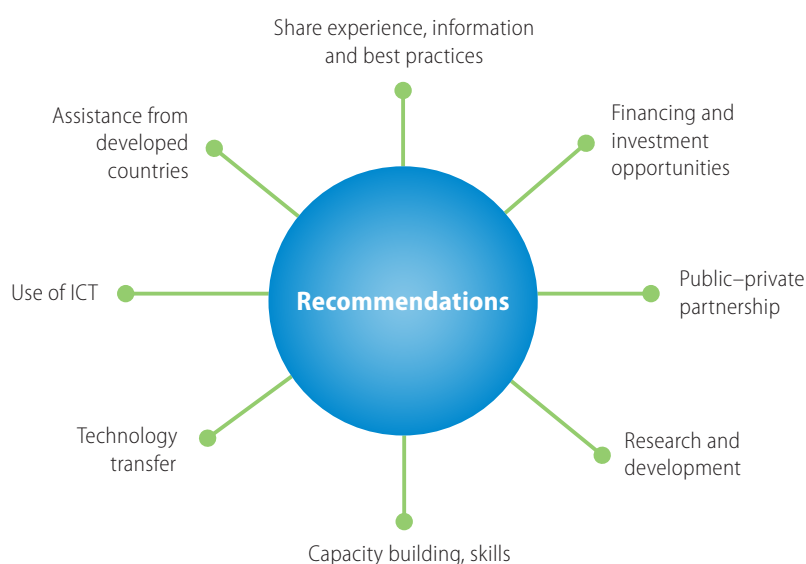
The Second IORA Ministerial Blue Economy Conference (BEC-II) on 'Financing the Blue Economy' took place in May 2017 in Jakarta, Indonesia, and addressed

several topics.³² The port sector was targeted, and specifically the port network, customs network, and management of goods. One of the recommendations of the Second IORA Blue Economy Core Group Workshop in China,³³ was to develop a methodology through which IORA Least Developed Countries (LDCs) would be able to approach the IORA Secretariat for assistance in the area of legislation and skills development to support their Blue Economy initiatives. The main areas of cooperation that have been recommended by Member States at port-related events are summarised in Figure 9.3.

Specific areas of cooperation were recommended, *inter alia*:

- Sustainable development of port infrastructure and port services; port-led special economic zones.
- Inland Container Depots (ICDs), multi-model operations and inland waterways.
- Maritime connectivity.
- Port and customs networks.
- Digitalisation of port and customs services for improved competitiveness of the maritime sectors; and e-custom strategies to facilitate trade and investment.
- Ship registration and port logistics.
- Environmental protection and management in ports.
- Establishment of an IORA Port Services Network to improve best services.

Figure 9.3: Main Areas of Cooperation Recommended by Member States at IORA Port-Related Events



Source: Compiled by the Author

Offshore hydrocarbons and seabed minerals

The Indian Ocean region includes seabed resources which represent a high potential for development both within and outside national jurisdictions. Mineral resources of primary interest to investors in the Indian Ocean include polymetallic nodules and polymetallic massive sulphides, although other minerals can also be found in the Indian Ocean coastal sediments. The International Seabed Authority (ISA) is responsible for organising, controlling and administering mineral resources beyond the limits of national jurisdiction. The ISA has to date approved 17 contracts, three of which are in the Central Indian Ocean.³⁴

The Indian Ocean has been identified as one of the sites with the greatest density of nodules, covering an area of 10–15 million km². Its resources are estimated at approximately 150 billion tonnes,³⁵ which represents potentially valuable resources for future exploitation in IORA. Seabed exploration in the Indian Ocean has already started. India has been exploring polymetallic nodules in the Central Indian Ocean basin since 1987,³⁶ and China has been given the right to explore 10,000 km² of the polymetallic sulphide area in the Southwest Indian Ocean since 2011.³⁷

Exploration activities are being conducted both inside and outside national jurisdictions. This rapid increase in activity brings with it environmental, legal and economic challenges. However, most of the mineral exploration, including that done on the continental margins of the Indian Ocean, has been carried out by developed countries from outside the region, with countries bordering the Indian Ocean providing limited resources.

Regulatory framework

Despite the great opportunities that the seabed mining sector represents for development and expansion in the territorial waters of coastal nations, very few IORA Member States have the capacities, resources, skills and technology to tap these resources. In terms of regulatory framework, only 11 of the 21 Member States have regulatory frameworks on seabed exploration and have ratified the United Nations Convention on the Law of the Sea (UNCLOS).

Research and development

Research and development in the seabed exploration and mining sector are still underdeveloped, with very few IORA Member States being actively involved in this process. An exploration contract was issued to the Government of India by the International Seabed Authority (ISA) for exploration of an area of 75 000 km² in

the Central Indian Ocean Basin (CIOB) from 2002 to 2017. These rights have been extended for a further five years.³⁸

Human resource development and capacity building

Apart from some universities in the Indian Ocean region that address certain aspects of seabed exploration and mining, capacity building and human resource development are limited. IORA Member States need to strengthen their collaboration and cooperation with more experienced countries, as well as with regional organisations and institutions such as the International Seabed Authority.

Events on seabed minerals and hydrocarbons

A workshop on the exploration and development of seabed minerals and hydrocarbons was held in Bali, Indonesia in 2015.³⁹ The participants recommended that the following principles should underpin growth:

- *Sustainability.* Noting the ongoing challenges to healthy oceans and their importance to environmental health, economic sustainability and the livelihood of Indian Ocean Rim countries, workshop participants upheld the importance of the sustainable development approach agreed upon and as articulated in the SDGs. Assessment of sustainability should include environmental and social values, in addition to economic value – a triple bottom-line assessment – and clear mechanisms to ensure the flow of benefits to communities.
- *Strong legal and governance regimes.* The participants agreed that a stable and consistent regulatory environment should be established prior to engaging in seabed mineral or hydrocarbon development activities. In noting the importance of public-private partnerships it was agreed that a robust and transparent regulatory framework ensures greater certainty for both government and industry, enabling private sector participation and facilitating investment.
- *Regional cooperation.* Recognising the importance of long-term and large-scale information for the successful management of Indian Ocean resources, the participants noted the value of cooperation among the States. The workshop participants identified the need for collaboration to build regional understanding of the ecosystems and resources of the Indian Ocean. The participants also recognised the importance of sharing national experiences, particularly in relation to data collection and management, as well as regionally consistent legal and governance frameworks.
- *Community engagement.* The participants agreed that community engagement was critical to ensure transparency and establish the 'social licence' to operate.

Such engagement would assist in establishing best-practice environmental standards and in developing integrated approaches that take into account the multiple uses of ocean space.

Blue Economy opportunities, challenges and expectations in IORA

The shift from a conventional resource economy to sustainable development of the Blue Economy represents huge economic and investment opportunities.⁴⁰ Member States have therefore identified its development as a driver of economic development, job creation and poverty alleviation. IORA Member States have reached consensus on various ways to promote the sustainable development of the different sectors of the Blue Economy, for example, by adopting the Blue Economy Declarations, the IORA Action Plan and the Jakarta Concord, which are described below.

The Mauritius Declaration on the Blue Economy

The First IORA Ministerial Blue Economy Conference held in Mauritius in September 2015 saw the adoption of the Mauritius Declaration on the Blue Economy (Annex 9.1), which seeks to harness ocean resources in a sustainable manner. The Declaration recognises the importance of the Blue Economy vis-à-vis:

- Fisheries and Aquaculture to ensure food security and contribute to poverty alleviation and sustainable livelihoods;
- Renewable Ocean Energy to reduce the cost of energy and to mitigate the impact on the environment and climate change;
- Seaport and Shipping to promote trade, investment and maritime connectivity in the Indian Ocean Rim region; and
- Offshore Hydrocarbons and Seabed Minerals to foster new business opportunities and attract investment in the Indian Ocean.

The Declaration also encouraged Member States to manage their ocean resources in a sustainable manner, adhering to the Sustainable Development Goals (SDGs) and in particular Goal 14 regarding the conservation and sustainable use of the oceans, seas and marine resources for development, as well as for the socio-economic benefit of the population. The need to enhance capacity development, strengthen networking, technology transfer, exchange of experiences and best practices in relation to the development of the Blue Economy in the Indian Ocean Rim region are also recognised in the declaration.

The involvement of Dialogue Partners, regional and international organisations, public and private partnership and businesses, and a focus on women's empowerment, are considered critical factors in supporting the sustainable development of the Blue Economy. As pointed out in the Declaration, there is also a need to establish or revise regional regulatory frameworks and governance to align with the development of the Blue Economy in the region. To do so it is necessary to draw on existing case studies and experiences, some of which are included in this Handbook. In addition, it has also been stressed that sustainable use of marine resources should be carried out in accordance with international law, including UNCLOS and the Convention on Biological Diversity.⁴¹

IORA Action Plan 2017–2021 and the Jakarta Concord

At the IORA Leaders' Summit that took place on 7 March 2017, in Jakarta, Indonesia, leaders of Member States adopted the IORA Action Plan 2017–2021 and signed the Jakarta Concord, which seeks to strengthen collaboration for enhanced regional cooperation towards a peaceful, stable and prosperous Indian Ocean.⁴² The Jakarta Concord is a strategic document that is considered to be a milestone initiative and is viewed as an important instrument to guide Member States in developing the IOR region through close collaboration and cooperation. All Member States are committed to adhering to the Concord and to ensuring balanced economic development in the region, as well as sustained growth and development in this strategically vital region.

At the Summit, IORA Member States committed themselves to a number of action areas:⁴³ promoting maritime safety and security in the region; enhancing trade and investment cooperation in the region; promoting sustainable and responsible fisheries management; enhancing disaster risk management; and strengthening academic, science and technology cooperation.

The IORA Action Plan, caters for the establishment of a Working Group on the Blue Economy (WGBE), which will bring together experts, academia, scientists and relevant stakeholders from IORA Member States to discuss issues of importance to IORA, advise on the implementation of projects based on recommendations by Member States, and discuss the way forward in sustaining blue growth. South Africa's Department of Environmental Affairs will lead this effort.

The Jakarta Declaration on the Blue Economy

The Jakarta Declaration on the Blue Economy (Annexure 9.2) was adopted at the Second IORA Ministerial Blue Economy Conference on 8-10 May 2017 in Jakarta, Indonesia. This Declaration intends to implement the IORA Action Plan of

2017–2021 as adopted by the Council of Ministers' (COM) Meeting in Jakarta, Indonesia, on 6 March 2017. In addition, this declaration highlights the importance of encouraging the financing of ocean economy infrastructure and development projects; enhancing research and development, networking, technology transfer, sharing of information, data and best practices, exchange programmes and expertise, and networking in the Indian Ocean Rim region; adopting ecosystem-based approaches to the sustainable management and use of marine resources, while protecting and conserving the marine environment; capacity building in various Blue Economy areas; addressing the challenges of IUU fishing, climate change impacts, managing and reversing marine plastic debris pollution, nutrient pollution, biodiversity loss, among others; and encouraging public-private partnerships and the involvement of business communities in developing the Blue Economy.

Revitalising the IORA Fisheries Support Unit

The IORA Fisheries Support Unit (FSU) was officially launched in Oman in May 2004, with Ministerial Decree No.34/2004 issued by the Ministry of Agriculture and Fisheries in Oman. The FSU, one of the specialised agencies of the IORA, plays an important role in fisheries management. The Unit addresses strategic issues in the fisheries and aquaculture sectors in the IOR region, within the framework of the IORA Charter, and facilitates dialogue between investors and the Member States regarding strategic matters.

Since its establishment, the FSU has hosted a number of meetings, including the workshop on 'fish otolith-base ageing and stock assessment' held on 23–31 October 2013, which enabled participants to enhance their knowledge on fish otolith and its use in ageing and stock assessment, and the FSU - IORA Workshop on 'Seafood Products Safety and Quality', which was held on 6–10 November, 2016, in Muscat, Sultanate of Oman. All IORA workshop reports are available from the author. With its 5-year action plan, FSU aims to enhance cooperation among the IORA Member States in the fisheries sector; improve the utilisation of fisheries resources; enhance expertise exchange; and conduct joint research activities.

Cooperation with dialogue partners

The IORA has seven Dialogue Partners, namely China, Egypt, France, Germany, Japan, United Kingdom and United States of America, all of which are developed and stable countries that have resources in terms of skills, capacities, experience and technological advancement. Through its IORA Action Plan and the Jakarta Concord, IORA is committed to deepening links and relations with Dialogue Partners.

The Mauritius Declaration on the Blue Economy recognises the need of Member States and Dialogue Partners to:

promote proper management of marine resources and enhance capacity building in developing countries, Small Island Developing States (SIDS) and Least Developed Countries (LDCs), encourage them to enhance capacity for the protection of coastal areas, marine environment and resources; facilitate and allocate the availability of sufficient funding from all sources to promote mutual cooperation and technology transfer with regards to the sustainable development of the Blue Economy; Improve research, networking, and promoting researchers' exchange programmes; and promote capacity building for the development of professional skills for the sustainable development and sound environmental management of different sectors in the Blue Economy.

Public-private partnership

The role of public-private partnerships to enhancing productivity and marketing efforts in different sectors of the Blue Economy, as well as in infrastructure development, is also highlighted in the Mauritius and the Jakarta declarations on the Blue Economy as well as in the Jakarta Concord. For example, the Jakarta Declaration highlights the need to promote public-private partnerships and the involvement of business communities in developing the Blue Economy, including infrastructure development and transfer of technology in various blue economy sectors such as fisheries and aquaculture; ocean observation; renewable ocean energy; seaport and shipping; deep sea mining and marine tourism, including cruise tourism. In addition, in some of the IORA Blue Events, Member States also recommended that public-private-partnerships be supported with a view to optimising the benefits derived from developing sectors related to Blue Economy cooperation in the IOR region; developing marine aquaculture, introducing seaweed culture in the IOR region; supporting infrastructural development and the improvement of technology; disseminating information and feedback throughout the IOR region; developing fisheries and aquaculture; offshore hydrocarbons and seabed minerals sector in the Indian Ocean region.

Strengthening the involvement of the private sector, in particular small and medium enterprises (SMEs), through regular dialogue and interactions between governments and businesses, including women-owned businesses, was recognised as an important way to promote trade and investment in the region.

Business opportunities

The Blue Economy Declaration highlighted the importance of creating a positive business environment for the development of the Blue Economy, which would attract foreign investment and boost growth. IORA Member States are committed to exploring and exploiting to maximum effect the opportunities presented by the Blue Economy. They are therefore promoting cooperation with the private sector and other relevant stakeholders. For example, in the context of the trend towards open regionalism and market-friendly policies, the IORA Business Forum (IORBF) promotes a consensus-based approach to business agreements. Its objectives are to formulate and implement programmes for economic cooperation in IORA priority sectors, including trade and investment, tourism and the Blue Economy. It also facilitates closer interaction among industry, academic institutions, scholars and publics of Member States and coordinates its activities with other non-governmental regional business networks wherever necessary.

Conclusion

Although IORA Member States are committed to ensuring that the Blue Economy becomes the main driver of socio-economic development, many Member States are still in the infancy stage. The establishment of an IORA Blue Economy Working Group to coordinate direct sustainable Blue Economy development according to the IORA Action Plan currently underway will lead to further enriching the Blue Economy paradigm in the region. The need for capacity building, skills and human resource development, research and development, networking, technology transfer, information-sharing, data and best practice, exchange programmes and expertise, and networking remain the priorities of most IORA Member States. The importance ascribed to public-private partnerships and the involvement of IORA Dialogue Partners in financing and developing this sector.

IORA recognises the importance of collaborating with organisations, institutions and centres of excellence that have made advances in the sector. Such partnerships will contribute to economic growth, job creation, enhanced trade and investment, food security and poverty alleviation. IORA is also encouraging its Member States to initiate meaningful projects and pilot projects that address specific issues in line with the Mauritius and the Jakarta declarations on the Blue Economy. Proper regulatory institutional frameworks and ocean management policies are of critical importance, if Member States are to structure and guide blue growth in a sustainable and sound manner.

Mauritius Declaration on Blue Economy

Declaration

Declaration of the Indian Ocean Rim Association on enhancing Blue Economy Cooperation for Sustainable Development in the Indian Ocean Region

Mauritius

2–3 September 2015

We, the Ministers and representatives of the Member States of the Indian Ocean Rim Association (hereinafter referred to as “IORA”), Australia, Bangladesh, Comoros, India, Indonesia, Kenya, Madagascar, Mauritius, Mozambique, Sultanate of Oman, Seychelles, Singapore, South Africa, Sri Lanka, Tanzania, Thailand and United Arab Emirates, attended the First IORA Ministerial Blue Economy Conference in Mauritius on 2–3 September 2015;

RECOGNISING the importance of the Blue Economy vis-a-vis:

- **Fisheries and Aquaculture** to ensure food security and contribute to poverty alleviation and sustainable livelihoods;
- **Renewable Ocean Energy** to reduce the cost of energy and to mitigate and adapt to the impact of climate change;
- **Seaport and Shipping** to promote trade, investment and maritime connectivity in the Indian Ocean Rim region; and,
- **Offshore Hydrocarbons and Seabed Minerals** to foster new business opportunities and attract investment in the Indian Ocean;

RECOGNISING the need of Member States and Dialogue Partners to promote proper management of marine resources and enhance capacity building in developing countries, small island developing states (SIDS) and least developed countries (LDCs);

REAFFIRMING IORA's role to promote collaboration and cooperation in the Blue Economy for balanced economic development among IORA Member States and dialogue partners;

ENCOURAGING IORA Member States and Dialogue Partners to enhance capacity for the protection of coastal areas, marine environment and resources to ensure sustainable development in the Indian Ocean Rim region;

RECALLING the Rio +20 United Nations Conference on Sustainable Development held in Rio de Janeiro, Brazil on 20-22 June 2012, that integrates social, economic and environmental goals and objectives for decision-making;

RECALLING the IORA Perth Principles for peaceful, productive and sustainable use of the Indian Ocean and its resources agreed by IORA Ministers in Perth, Australia on 1 November 2013; and the IORA Economic Declaration adopted by IORA Ministers in Perth on 9 October 2014, which recognised that the blue economy is emerging as a common source of growth, innovation and job creation for the Indian Ocean Region;

RECALLING the establishment of the Blue Economy Core Group and the conduct of the preparatory workshops for the First IORA Ministerial Blue Economy Conference (BEC) including: (i) The IORA Blue Economy Core Group Workshop on “Promoting Fisheries & Aquaculture and Maritime Safety & Security Cooperation in Indian Ocean Region” that was held in Durban, South Africa, on 4-5 May 2015; (ii) The Indian Ocean Region Workshop on “Exploration and Development of Seabed Minerals and Hydrocarbons: Current Capability and Emerging Science Needs” that took place in Bali, Indonesia from 26-27 July 2015, and; (iii) the IORA Dialogue on the Blue Economy in Goa, India on 17-18 August, 2015;

RECALLING the Third International Conference on Financing for Development that was held in Addis Ababa, Ethiopia, from 13-16 July 2015 that holistically looked at financing for development across three dimensions and addressed the way in which inclusive growth and sustainable development can be achieved to address issues, including: sustainable energy; climate change; disaster risk reduction; oceans and seas; food security and nutrition; sustainable transportation; gender equality and women’s empowerment; and, biodiversity;

RECOGNISING the importance of the proposed Sustainable Development Goals (SDGs) for the Blue Economy, especially for the conservation and sustainable use of the oceans, seas and marine resources for development;

RECALLING IORA’s commitment to develop a common vision in making the Blue Economy an engine for sustainable development and sound environmental management in the Indian Ocean Region;

RECONFIRMING IORA’s belief in promoting an innovative and sustainable Blue Economy in the Indian Ocean Region;

COMMITTING to optimization of the populations’ benefit from the economic activity of the ocean;

REITERATING the importance of IORA's cooperation and engagement with Dialogue Partners, relevant international and regional organizations, the private sector, and civil society in delivering Blue Economy objectives;

HEREBY DECLARE AS FOLLOWS:

That the Member States of IORA will be guided by the following principles in our shared goal to foster the sustainable development of the Blue Economy in the Indian Ocean Region:

1. The Blue Economy paradigm is founded on the ecosystem approach, including science-based conservation of marine resources and ecosystems, as a means to realise sustainable development;
2. IORA's priority sectors of the Blue Economy, including Fisheries and Aquaculture, Renewable Ocean Energy, Seaports and Shipping, and Offshore Hydrocarbons and Seabed Minerals, which should be developed in an environmentally sound manner for the socio-economic benefit of the population;
3. Sustainable use of marine resources of the Indian Ocean should be carried out according to international law, including UNCLOS and the Convention on Biological Diversity;
4. Member States are also encouraged to consider formulating measures for the development of the Blue Economy in a sustainable manner;
5. Cooperation by IORA Member States on data collection and the development of environmental baselines could ensure a strong foundation for informed decision making and policy development;
6. IORA Member States shall promote sustainable fisheries, including combating illegal unreported and unregulated (IUU) fishing;
7. The role of the IORA Blue Economy Core Group will focus on Fisheries and Aquaculture, Renewable Ocean Energy, Seaports and Shipping, and Offshore Hydrocarbons and Seabed Minerals, to promote the Blue Economy as a driver for sustainable development; research and development; investment, technology transfer and capacity building should be encouraged so as to explore the full potential of the oceans and to ensure sustainable development in the Indian Ocean Rim region;
8. IORA Member States should attach higher importance to the sustainable development of the Blue Economy and should be encouraged to strengthen networking, and the exchange of experiences and best practices in relation to the development of the Blue Economy in the Indian Ocean Rim region;
9. Member States and Dialogue Partners should be encouraged to facilitate and allocate sufficient

funding from all sources to promote mutual cooperation and technology transfer with regard to the sustainable development of the Blue Economy in the Indian Ocean Rim Region;

10. The sustainable development of the IORA priority sectors of the Blue Economy in the Indian Ocean Region would contribute to: food security; poverty alleviation; the mitigation of and resilience to the impact of climate change; enhanced trade and investment; enhanced maritime connectivity; economic diversification; job creation and socio- economic growth;
11. The empowerment of women and facilitating the participation of micro, small and medium enterprises in the development of the Blue Economy is essential to equitable and sustainable economic growth;
12. Improving research, networking, and promoting researchers' exchange programmes among Member States and Dialogue Partners is vital to ensure sustained development in the region: taking advantage of the upcoming UNESCO Indian Ocean Expedition II (IOEII) as endorsed by the 2014 Perth Communique;
13. The need to involve public-private partnerships to enhance productivity and marketing efforts in different sectors of the Blue Economy;
14. The need to set-up or revise existing regional regulatory frameworks and governance with regard to the development of the Blue Economy in the region, drawing upon existing case studies and experience where it exists;
15. The participation of multilateral organisations can make a valuable contribution to the sustainable development of the Blue Economy;
16. Blue Economy development in Member States would create a conducive business environment and attract foreign investment to boost growth;
17. Member States and Dialogue Partners should promote capacity building for the development of professional skills for the sustainable development and sound environmental management of different sectors in the Blue Economy.

ADOPTED by the Blue Economy Ministers and Senior Officials of the Member States of the Indian Ocean Rim Association on 03 September 2015 in Mauritius.

Jakarta Declaration on Blue Economy

Declaration

Declaration of the Indian Ocean Rim Association on the Blue Economy in the Indian Ocean Region

Jakarta, Indonesia

8–10 May 2017

We, the Ministers and representatives of the Member States of the Indian Ocean Rim Association (hereinafter referred to as “IORA”), the Commonwealth of Australia, the People’s Republic of Bangladesh, the Union of Comoros, the Republic of India, the Republic of Indonesia, the Islamic Republic of Iran, the Republic of Kenya, the Republic of Madagascar, Malaysia, the Republic of Mauritius, the Republic of Mozambique, the Sultanate of Oman, the Republic of Seychelles, the Republic of Singapore, the Federal Republic of Somalia, the Republic of South Africa, the Democratic Socialist Republic of Sri Lanka, the United Republic of Tanzania, the Kingdom of Thailand, the United Arab Emirates and the Republic of Yemen, attended the Second IORA Ministerial Blue Economy Conference (BEC-II) in Jakarta, Indonesia, on 8–10 May 2017;

RECALLING

- the 1982 United Nations Convention on the Law of the Sea (UNCLOS) and other international conventions and instruments related to the activities in the oceans and seas;
- Goal 14 of the Sustainable Development Goals (SDGs), to conserve and sustainably use the oceans, seas and marine resources;
- the Recommendations and the Declaration of the First Ministerial Blue Economy Conference in Mauritius on 2-3 September 2015;
- the Jakarta Concord on Promoting Regional Cooperation for A Peaceful, Stable and Prosperous Indian Ocean, signed in Jakarta, Indonesia, on 7 March 2017;
- Relevant UNGA Resolutions, including 61/105, 64/72, 66/68, 69/292;

RECALLING ALSO the intention to implement the IORA Action Plan of 2017-2021, as adopted by the Council of Ministers’ (COM) Meeting in Jakarta, Indonesia, on 6th March 2017;

RECOGNISING that oceans, along with coastal and marine resources, play an essential role in human well-being and social and economic development;

STRESSING the need for the IORA Member States to harness the potential of the Blue Economy to promote economic growth, job creation, trade and investment, and contribute to food security and poverty alleviation, whilst safeguarding the ocean's health through the sustainable development of its resources;

CONCERNED about the disparities in economic development of the IORA Member States, including in skills and human resource development, research and development, business opportunities, resource allocation, and technology and innovation, and its impact on the public and private sector, including small and medium enterprises (SMEs);

AWARE OF the need to promote communication and maritime connectivity in the Indian Ocean region;

STRESSING the need to promote observation, protection, conservation and sustainable use of ocean resources, so as to continue to meet the needs of the present without comprising the opportunities of future generations;

REAFFIRMING that research and investment are required to address key challenges of the IORA and to provide solutions and create a friendly business environment to attract investors in the Blue Economy in the Indian Ocean region;

RECOGNISING the importance of promoting entrepreneurship, innovation and SMEs, with a special focus on promoting youth and women's engagement in the sustainable development of the Blue Economy;

MINDFUL OF the increasing challenges, both natural and human factors, such as over-exploitation of resources, increasing marine plastics debris and nutrient pollution, illegal, unreported and unregulated (IUU) fishing, over-fishing, destructive fishing, crime in the fisheries sector, biodiversity loss and its impact on blue carbon stocks, illegal mining and the impact of global climate change and natural disasters;

ENCOURAGING the IORA Member States to move towards integrated and ecosystem-based approaches in the management of marine resources to maximise sustainable economic yield from the ocean, including through utilising the appropriate management tools such as marine spatial planning, marine protected areas, etc;

RECOGNISING the importance of public-private partnerships in the development of and cooperation on the Blue Economy;

ENCOURAGING sharing of information, experiences, expertise, best practice and technology in Blue Economy related cooperation among IORA Member States and Dialogue Partners;

ACKNOWLEDGING the outcomes of IORA Blue Economy events on various related topics, including marine aquaculture, marine tourism, post-harvest processing, seafood safety and quality, maritime connectivity, port management and operation, ocean observation monitoring, forecasting and seabed minerals and hydrocarbons;

HIGHLIGHTING the importance of collaborating and cooperating with relevant stakeholders, including regional and international organisations for the advancement of the Blue Economy in the Indian Ocean region;

ENCOURAGING the IORA Member States to mainstream ocean-related issues in their national planning and policy-making process, based on their priorities;

EMPHASISING the need to foster support and financing opportunities, as well as promote technology transfer, capacity building and skills development, for local fishery entrepreneurs and coastal communities that are directly dependent on the sea, including through triangular cooperation;

REAFFIRMING IORA's role and commitment in the development of the Blue Economy, through the sustainable use, management, observation, protection and conservation of marine resources in the Indian Ocean region;

REITERATING the commitment to establish the IORA Working Group on the Blue Economy, which would enhance cooperation to promote the Blue Economy.

We, the Blue Economy Ministers/Head of Delegations of the Member States of the Indian Ocean Rim Association

HEREBY DECLARE AS FOLLOWS:

That the Member States of IORA will be guided by the following principles when developing and applying blue economy approaches to sustainable development and the enhancement of socio-economic benefits, particularly of coastal communities in the Indian Ocean Region:

1. The Blue Economy should ensure the sustainable management and protection of marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and taking action for their restoration, in order to maintain healthy and productive oceans, and achieve inclusive economic growth in the Indian Ocean region;
2. The development of IORA's Blue Economy priority sectors (namely: Fisheries and Aquaculture; Renewable Ocean Energy; Seaports and Shipping; Offshore Hydrocarbons and Seabed Minerals; Deep Sea Mining, Marine Tourism; and Marine Biotechnology, Ocean Observation, Research and Development) should be carried out in an environmentally sustainable manner;
3. IORA Member States are encouraged to pledge their voluntary commitment, including in

implementing capacity building programs, in the concerted effort to strengthen cooperation on the blue economy;

4. IORA Member States are encouraged to develop their Blue Economy sectors, based on their priorities and which could contribute to boosting their economic growth and contribute to job creation and poverty alleviation;
5. IORA Member States, in collaboration with Dialogue Partners, should encourage the financing of ocean economy infrastructure and development projects, including development and investment in Economic Development Zones, as well as investment and exploration of new technologies for Blue Economy Development;
6. IORA Member States and Dialogue Partners should enhance cooperation and collaboration to promote: research and development; networking; technology transfer; sharing of information, data and best practice; exchange programmes and expertise; and networking across the Indian Ocean region for the sustainable development of the Blue Economy;
7. IORA Member States should adopt ecosystem-based approaches to sustainably manage and use their marine resources, while protecting and conserving the marine environment;
8. IORA Member States are encouraged to consider the full range of technologically advanced solutions, as well as local wisdom and traditional knowledge, as appropriate, in the context of an adaptation and mitigation strategy to confront climate change effects on societies;
9. IORA Member States, in collaboration with Dialogue Partners, should promote capacity building, including collaboration on ocean observation training, and scientific capacity and skills development in the Blue Economy sector, by reinforcing collaboration and networking with relevant regional/international organisations and institutions in the Indian Ocean region;
10. IORA Member States, in collaboration with Dialogue Partners, need to address challenges and key issues related to the Blue Economy, including over-exploitation of resources, marine plastics debris pollution and nutrient pollution, biodiversity loss, IUU fishing, illegal mining, climate change and its impact on marine resources and ecosystems;
11. Collaboration between IORA Member States and Dialogue Partners in various aspects, including financing and development of Blue Economy activities and projects, and technology transfer should be strengthened so as to ensure balanced economic development in the Indian Ocean region;
12. Cooperation among IORA Member States, Dialogue Partners and relevant stakeholders in: carrying out marine scientific research; sharing, collecting and managing data and information; and the implementation of concrete projects on emerging ocean science and blue economy issues;
13. The development of effective legal, regulatory and institutional frameworks and ocean

management policies should be enhanced, as appropriate, for informed decision and policy-making, which are crucial steps toward structuring and guiding its growth;

14. Sustainable development of the Blue Economy should be in accordance with the 1982 United Nations Convention on the Law of the Sea (UNCLOS);
15. IORA Member States are encouraged to promote public-private partnerships and the involvement of business communities in developing the Blue Economy, including infrastructure development and transfer of technology in various blue economy sectors, such as: fisheries and aquaculture; ocean observation; renewable ocean energy; seaport and shipping; deep sea mining and marine tourism, including cruise tourism;
16. IORA Member States should cooperate to promote efficient monitoring and inspection programmes to prevent maritime trade of uncertified/unauthorized chemicals and pesticides;
17. IORA Member States consider, if deemed necessary, supporting the establishment of an IORA business travel card to ease business travel on blue economy businesses and collaborate with member countries who are ready to do so;
18. IORA Member States, in accordance with international laws and consistent with existing obligations, should perform environmental impact assessments before engaging in relevant deep sea mining activities and fulfil relevant obligations to ensure effective protection of the marine environment from any harmful effects of deep sea mining;
19. IORA Member States are encouraged to adopt and implement transparency and traceability measures to strengthen the application of sustainable fishing practices by regulating harvesting and ending poverty, the fight against IUU Fishing destructive fishing and crimes in the fisheries sector, provide access to small scale artisanal fisheries to marine resources and markets, and protect food security;
20. The empowerment of women and youth to participate in the development of the blue economy is essential, through better access to education, training, technology and finance. Women and youth should be encouraged (especially by supporting MSMEs and small scale fisheries) to be equitably included in sustainable economic growth;
21. The proposed Working Group on the Blue Economy will consider programs, activities, pilot projects and studies for regional cooperation in the Blue Economy;
22. IORA Member States to consider developing a Master Plan on the Blue Economy to identify and prioritize concrete projects and tangible areas of cooperation, to promote the blue economy as a driver of socio-economic development;
23. The sustainable development of the IORA priority sectors of the Blue Economy in the Indian Ocean Region would contribute to: food security; poverty alleviation; the mitigation of and

resilience to the impact of climate change; enhanced trade and investment; enhanced maritime connectivity; economic diversification; job creation and socio-economic growth;

24. IORA Member States and Dialogue Partners should increase the economic benefits derived from the Blue Economy by Small Island developing States (SIDs) and least developed countries (LDCs), from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism;
25. Collaboration among IORA Member States, Dialogue Partners, research institutions, industries and public-private partnerships should be enhanced, so as to create an environmentally sound business environment and attract foreign investment that would accelerate the commercialisation of ongoing research in exploring data and in creating new products derived from marine and maritime data resources;
26. IORA Member States, in collaboration with Dialogue Partners, are encouraged to carry out pilot projects and set-up modern and accessible technologies to effectively develop the Blue Economy in a sustainable manner.

ADOPTED by the Blue Economy Ministers/Head of Delegations of the Member States of the Indian Ocean Rim Association on 10 May 2017 in Jakarta, Indonesia.

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SECTION III

The Socio-Economic Benefits of the Blue Economy

South Africa's Ocean Economy and Operation Phakisa

Lessons Learned

Ken Findlay and Narnia Bohler-Muller

Introduction

South Africa's experience with the Oceans Economy Initiative of Operation Phakisa places this Member State of the Indian Ocean Rim Association (IORA) in a good position to share knowledge, skills and lessons that would be of benefit to other Member States, and to learn from other such initiatives in the region. The first section of this chapter sketches out the context and background of Africa's and South Africa's approach to the oceans economy; the second section outlines the key aspects of Operation Phakisa and the successes and challenges it faced; the third section considers the importance of Marine Spatial Planning (MSP) in order to ensure sustainable governance of the oceans; section four highlights lessons learned; and the chapter ends with recommendations for consideration by other Member States in the policy arena.

In August 2016, the global human population was estimated at 7.4 billion.¹ The pressure exerted by the human population on the Earth system has long been a cause of concern,² as the alteration of ecosystems caused by human enterprise may compromise the potential capacity of systems to provide the ecosystem services critical to human wellbeing. From the mid-twentieth century onwards, the 'Great Acceleration' concept identified a marked increase and dramatic alteration in the rate of human enterprise, economic activity, consumption and associated resource use.³ Linked to these expanding human activities, the Planetary Boundaries framework⁴ defines a safe operating space for humanity, based on ceiling targets in changes to nine biophysical processes that regulate the Earth system.

The expanding human population and its associated accelerated consumption of finite resources have led nations and regions to turn to new economic opportunities to foster the economic growth required to meet societal needs. Humans derive considerable benefits (both market and non-market value goods and services) directly or indirectly from ecosystems,⁵ including from ocean ecosystems. Benefits recognised by the Common International Classification of Ecosystem Services (CICES)⁶ are:

- Provisioning services – the market benefits produced by, in or on the ecosystem and arising in the economy through private sector and public sector components.
- Cultural services – the non-market intellectual and symbolic benefits that people obtain from their environment, including aesthetic benefits.
- Regulatory services – the non-market ecological services of ecosystems in environmental regulation.

Ecosystem health and integrity call for the provision of supporting ecosystem services, which form the bases of the above final ecosystem services. Supporting services are defined by CICES as ‘the underpinning structures and processes that ultimately give rise to ecosystem services’ and are not considered as final ecosystem services. Over and above the ecosystem services, there are a number of environmental resource-use services (such as mining), which are not dependent on functioning ecosystems, but have considerable potential to impact support-service provision.

Against this background and within this context, it is important to understand what is meant by the concepts ‘oceans’ economies or ‘blue’ economies and to place the need for sustainability and equitable resource allocation in perspective. The next section considers these pressing issues.

Oceans Economies, Blue Economies and Global Ocean Sustainability

The oceans cover some 70 per cent of the surface area of the Earth, and ocean ecosystems provide considerable market and non-market goods and services benefits to human populations⁷ (such as fisheries as a provisioning service, CO₂ absorption as a regulatory service, or non-market recreation as a cultural service). Such goods and services (or at least the market service activities or sectors) are increasingly being referred to as ‘the ocean economy’.⁸ Expansion in national or regional ocean economies has resulted from: a) growth of the established marine industry sectors; b) the extension of historically terrestrial industry sectors into the ocean space (e.g. agriculture to aquaculture), or; c) the advancement of emergent sectors into the

ocean space as ocean technology advances. However, the typology and terminology of the ocean economy sector is confusing, as different nations refer to their ocean economy in different ways, such as 'ocean economy', 'ocean industry', 'marine economy', 'marine industry', 'marine activity', and 'maritime sector', all tending to fall under the banner of 'exploitation' of the oceans at the possible expense of sustainability.

Additionally, it is difficult to compare ocean economies across countries or regions, as the definitions, classification standards and scope differ substantially. Many authors⁹ include only the private and public sector market components within their valuation of national oceans economies,¹⁰ but exclude non-market value components. Furthermore, the scope of the 'ocean economy' basket differs by region in terms of the extent of inclusion of downstream economic activities (e.g. fish processing) and land-based coastal economic activities because of the definition of the geographic extent of the coastal region.

The Rio+20 United Nations Conference on Sustainable Development (UNCSD) advanced the 'green economy' concept, while coastal nations proposed that a 'Blue Economy' approach be more prominently addressed. Initial expansion of the Blue Economy within the green economy was encapsulated in the 'Green Economy in a Blue World' report.¹¹ Whereas 'ocean economy' includes all the goods and services generated from the ocean space, the term 'Blue Economy' is taken to mean environmentally sustainable economic growth and the resultant wellbeing derived from the ocean.¹²

The Blue Economy is consequently considered to mirror a terrestrial green economy in the oceans and coastal areas. In this model, the classical economic growth metric of gross domestic product (GDP) needs to be supplemented by the state of natural capital and a measure of the distribution of the derived benefits to human welfare over time. Environmental sustainability, sustainable economic growth and social equity and wellbeing are all to be seen as integral pillars of a green / Blue Economy.

The fact that the majority of the world's oceans (the high seas) are global commons and that many of the global environmental externalities affecting the oceans are trans-boundary means that ocean resource use, management measures and conservation are dependent on international legislation. Rights and responsibilities require a high degree of international cooperation as well as the kind of regional cooperation that occurs through bodies such as the Indian Ocean Rim Association (IORA), which has embraced the importance of the Blue Economy and its related activities through, *inter alia*, supporting a Blue Economy Working Group¹³ as well as hosting an annual Ministerial Conference on the Blue Economy.¹⁴

Sustainable Coastal and Ocean Management has been advanced in a variety of forms. For example, Integrated Coastal and Ocean Management (ICOM) or Integrated

Coastal Zone Management (ICZM) or Integrated Coastal and Marine Area Management (IMCAM) have the Ecosystem Approach (EA) at their core. Alternatively termed the Ecosystem-Based-Approach (EBA) or Ecosystem-Based-Management (EBM)), and defined by the Convention on Biological Diversity (CBD) as ‘a strategy for the integrated management of land, water, and living resources that promotes conservation and sustainable use in an equitable way’, the EA focuses on:

- a) the functional relationships and processes within ecosystems;
- b) the distribution of the benefits derived from ecosystem services;
- c) the use of adaptive management practices;
- d) the need to carry out management actions at multiple scales; and
- e) inter-sectoral cooperation within ecosystem management.

In addition, Costanza et al.¹⁵ developed the ‘Lisbon principles’ of sustainable governance (responsibility, scale-matching, precaution, adaptive management, full cost allocation and participation) as core guidelines for sustainable ocean governance models. Altman et al.¹⁶ noted that challenges in marine EA implementation are compounded by the fact that many services arise from public goods, that ocean environments are inherently complex,¹⁷ and that marine resources have been over-used for decades.¹⁸

The ocean’s value to human endeavour has long been noted, with many countries calculating the value of their ocean economy. Valuation has, for the most, been based on a contribution to national GDP, which ignores social costs, environmental impacts and income inequality. Such valuations also make no provision for any deterioration in the natural capital from which ecosystem service values flow. The Millennium Ecosystem Assessment (MEA)¹⁹ suggested that measures of wellbeing arising from ecosystem services include:

- security: personal safety, security of resources and security from disasters;
- basic material of a good life: adequate livelihoods, sufficient food, shelter and access to goods;
- health: strength, feeling well and access to clean air and water;
- good social relations: social cohesion, mutual respect and ability to help others; and
- freedom of choice and action.

Many of these metrics remain unaccounted for in the Systems of National Accounts (SNA) framework, and the size and growth of national ocean economies are largely defined by GDP, despite the exclusion of important societal and environmental economic components.

Costanza et al.²⁰ argue that aggregate metrics of human and ecosystem well-being need to replace growth in GDP and link the development of new national economic metrics to the Sustainable Development Goals (SDGs) recently agreed to by the 193 UN member countries, including SDG 14 on Oceans and Seas.

The Indian Ocean Rim Association (IORA) adopted the shared goal to foster the sustainable development of the Blue Economy in the Indian Ocean region in 2013. Included in the adoption is the principle that 'the Blue Economy paradigm is founded on the ecosystem approach, including science-based conservation of marine resources and ecosystems, as a means to realise sustainable development'.²¹

Background to Africa's and South Africa's Approach to the Ocean Economy

Africa

Through its 2050 Africa Integrated Maritime (AIM) Strategy,²² which introduces the Blue Economy as the 'new frontier of African Renaissance', the African Union (AU) has played a significant role in developing and implementing a Blue Economy strategy in the African region. This Strategy identifies Africa's Maritime Domain (AMD) as having significant resources (including fisheries, aquaculture, tourism, transport, shipbuilding, energy, bio-prospecting, and underwater mining) and growth opportunities. Through the AMD's contribution to social, economic and political stability, and safety and security, African countries are able to promote sustainable development and wealth creation. The AIM Strategy delivers an extensive framework for both the protection and sustainable exploitation of the AMD, through the integration of an operational Plan of Action of achievable goals, objectives and activities for increased wealth creation in a stable and secure AMD.

Furthermore, Africa's Blue Economy is at the centre of the AU's Agenda 2063, as it draws on the ocean resources to drive Africa's transformation. The AU summit of January 2014 agreed that 'Africa's oceans are essential to the sustainable development of the continent and ... should play a critical role in shaping Africa's common position on the post-2015 development agenda'. Both the AU's Agenda 2063 and the AIM Strategy are strongly underpinned by sustainability values and Blue Economy principles. A number of African regional economic communities (RECs) and coastal states are developing Blue Economy strategic imperatives, including, for example, the Indian Ocean Commission (Comoros, Madagascar, Mauritius, the Seychelles and Reunion), Mauritius and South Africa.

In March 2016, the United Nations Economic Commission for Africa (UNECA) produced 'Africa's Blue Economy: A Policy Handbook'²³ describing the Blue Economy in Africa and outlining Blue Economy policy development, process and design, and the cross-cutting issues of partnerships for transformative actions, communication and outreach. A 'Blue Economy and Oceans Governance' workshop was held under the Nairobi Convention's 8th Conference of Parties Meeting in Mahe, the Seychelles, in 2015.²⁴ It was noted that the Nairobi Convention could assist countries at a technical level and advance the sharing of national experiences, particularly in relation to the Blue Economy, the SDGs, and AU Agenda 2063. MSP and a move away from GDP growth based economic metrics.

South Africa

The South African (RSA) National Development Plan Vision 2030²⁵ is the national socio-economic development blueprint aimed at eliminating poverty and reducing inequality by 2030. Modelled on the Malaysian Government's Big Fast Results (BFR) problem-solving methodology adapted for South African needs and requirements, the South African Government's Operation Phakisa is aimed at accelerating the execution of the National Development Plan (with Phakisa meaning 'to hurry' in South Africa's Sesotho language). The BFR methodology is an 8-step process that results in detailed plans to ensure successful implementation and effective monitoring of national priorities and fast-tracking of delivery.

The Operation Phakisa: Unlocking the Economic Potential of South Africa's Oceans initiative was officially launched in October 2014.²⁶ South Africa's heavy reliance on ocean ecosystems derives from its extensive ocean space, a coastline of almost 3900 km and an Exclusive Economic Zone of some 1.5 million km². In 2010, South Africa's ocean economy contributed approximately 54 billion to South Africa's GDP²⁷ and accounted for approximately 316,000 jobs. It has been estimated that the Operation Phakisa Ocean Economy initiative (OP-OE) will expand the ocean economy by some 20 billion ZAR by 2019.²⁸ Furthermore, the OP-OE has the potential to contribute up to 177 billion ZAR to GDP and between 800 and 1 million direct jobs in the long term.²⁹

Key Aspects of the Operation Phakisa Ocean Economy Initiative and the Successes and Challenges Faced

The OP-OE initiative began by identifying and analysing nine marine and maritime industry sectors as key priorities for advancement, including Marine Transport and

Manufacturing; Tourism; Offshore Oil and Gas; Construction; Renewable Energy; Fisheries and Aquaculture; Communication, Desalination and Marine Protection Services; and Governance. The criteria used for the selection of growth or delivery area advancement included:

- potential contribution to GDP and job creation;
- relevance to the marine ecosystem;
- geo-political, security and environmental implications;
- institutional and logistical capacity requirements for the growth area; and
- the novelty of the proposed growth area.

Initially, four growth areas (Marine Transport and Manufacturing Services; Offshore Oil and Gas Exploration and Production; Aquaculture; and Marine Protection Services and Governance) were selected from the nine industry sectors, with a further two (Small Harbour Development, and Marine and Maritime Tourism) added subsequently.

Each of these four delivery areas was the subject of an intensive six-week Ocean Economy Lab held in 2014, during which government, the private sector and civil society, labour and academia collaborated in identifying opportunities (including detailed problem analysis, intervention planning, priority setting and monitored implementation plans) to unlock the economic potential of the delivery area. Forty-seven prioritised initiatives (see Annexure 10.1) and over 400 key performance indicators were identified in the initial four delivery areas, while a further 14 were identified in the Small Harbour Delivery Area.³⁰ Furthermore, two enabler areas (Skills Development and Capacity Building, and Research Technology and Innovation) were identified in the process.³¹

Delivery Areas

The Marine Transport and Manufacturing (MTM) Delivery Area

The marine transport and manufacturing (MTM) delivery area³² suggested that South Africa could leverage both its strategic location and infrastructure to accelerate the growth of the MTM sector, including: cargo handling, national registry and flagging within the transport sector; vessel building, rig and ship repair, and offshore oil and gas (O&G) services within the marine manufacturing sector. The Lab identified 18 initiatives across the Infrastructure and Operations, Skills and Capacity Development and Market Growth areas that could potentially create 15 000 jobs and contribute over 18 billion ZAR to GDP by 2020 (See Annexure 10.1). The MTM Lab also identified the need to expand the use of small harbours

to drive economic growth through fisheries and other small coastal vessel activities (thereafter developed into a further Operation Phakisa initiative – see below). The MTM delivery area was to be managed by the Department of Transport (DoT).

The Offshore Oil and Gas Delivery Area

The Oil and Gas Lab found that South Africa was not maximising its economic potential from oil and gas exploration.³³ It identified five limiting factors, including: a) ineffective institutional arrangements for managing exploration and production (E&P); b) concerns about the environmental impact of the sector; c) a lack of legislative clarity within the sector; d) low uptake of the local supply chain, and; e) a paucity of local skills and technical capability to support E&P in South Africa. The Lab reported: that the country has possible (although uncertain) resources of approximately 9 billion barrels of oil and 11 billion barrels of oil equivalent of gas; and that the development of the upstream oil and gas industry could contribute significant value to the country through direct state revenue, job creation, re-investment opportunities and the development of associated downstream industries.

However, the Lab noted that oil and gas exploration requires significant (and high risk) financial and time investment, particularly in South Africa's deep-water offshore environment. The Lab identified eleven initiatives (see Annexure 10.1) in six areas Infrastructure, Environment, Supply Chain, Skills, Institutions and Legislation to advance this sector of the South African Ocean Economy. The offshore oil and gas delivery area was to be managed by the Department of Mineral Resources (DMR).

The Aquaculture Delivery Area

South Africa's marine aquaculture industry sector is currently nascent and small in extent, with production centred on high value species such as abalone, oysters, mussels and finfish, all of which have high production (and therefore market) costs.³⁴ The Lab noted that there was significant potential for sectoral growth, owing to both increasing market demand for fish and South Africa's abundance of marine and freshwater resources, and that the sector offered significant potential for rural development especially for marginalised coastal communities, despite being restricted in terms of available protected aquaculture sites along the South African high-energy coastline. The Aquaculture Lab identified the need to unlock that potential and grow aquaculture in the supply of fish products, job creation and contribution to the national income. The aquaculture Lab selected eight initiatives from an identified nine (see Annexure 10.1). The aquaculture delivery

area was to be managed by the Department of Agriculture Forestry and Fisheries (DAFF).

The Marine Protection Services and Governance Delivery Area

Maritime and marine environmental governance in South Africa is currently carried out in a highly sectoral fashion. There is a dire need for the implementation of an over-arching, integrated ocean governance framework, which would allow for sustainable growth in the ocean economy by balancing socio-economic benefits against the protection of ocean health. The Marine Protection Services and Governance delivery area would be overseen by an Oceans Secretariat with support from the Department of Environmental Affairs (DEA), the South African Department of Agriculture Forestry and Fisheries (DAFF) and the Department of Science and Technology (DST). Ten initiatives were identified,³⁵ and developed within the Marine Protection Services and Governance Lab (see Annexure 10.1), including the following eight initiatives:

- The review and enhancement of ocean-related legislation (MPS&G initiatives 2 and 3) as a result of the (currently) highly siloed nature of ocean governance in South Africa. The Department of Environmental Affairs is currently reviewing and developing integrated ocean legislation.
- Accelerated capacity-building intervention on ocean governance (MPS&G initiative 4): noting that many of the technical skills required for marine governance are scarce, the MPS&G Lab recommended the development of long-term capacity-building for oceans governance and enforcement in three areas, including in Marine Spatial Planning.
- Enhanced and coordinated enforcement programme (MPS&G initiative 5): noting that illegal and unregulated extraction or pollution activities have a significant negative impact on marine resources, which in turn results in substantial economic and employment losses, there needs to be enhanced enforcement.
- The development of a national ocean and coastal information system and an associated extension of earth observation capacity (MPS&G initiative 6): the development of a National Oceans and Coasts Information Management System (OCIMS) would result in a knowledge and information base for the development of the ocean and coast economy, including earth observation technology for both environmental and compliance monitoring.
- Noting the increasing coastal usage by the South African population, and that South Africa does not have a clear understanding of coastal and ocean water quality and pollution that is hazardous to human or environmental health,

initiative seven of the MPS&G Lab recommended that a national water quality monitoring programme be established to monitor coastal water quality as the ocean economy grows.

- Noting that marine resources play a critical role in the economy and welfare of many South Africans, and that too little of the South African ocean space is protected, initiative 8 of the MPS&G Lab recommended the establishment of a representative Marine Protected Area (MPA) network targeting a modest five per cent of mainland South Africa's EEZ.
- The growth of the OP-OE into a sustainable Blue Economy model requires a discovery, research and monitoring programme in SA's marine domain (under initiative nine of the MPS&G Lab), which is to result in the required data to enable effective Marine Spatial Planning and the establishment of a representative MPA network.
- Finally, the MPS&G Lab noted that there was no overall system to guide the development, implementation, monitoring and refinement of Marine Spatial Planning (MSP) frameworks in South Africa. The Lab identified (as initiative 10) the need for a national MSP framework, three regional frameworks (the West, South and East coasts) and sub-regional marine spatial plans. It was agreed that the resulting MSP frameworks need to be consultative and adaptive, with significant stakeholder engagement.

Two further OP-OE delivery areas in Small Harbour Development and Marine and Maritime Tourism have been developed subsequent to the initial four.

The Small Harbour Development Delivery Area

This delivery area arose from a mini-lab held within the MTM Lab and is led by the Department of Public Works (DPW) Small Harbour Development Unit. The objective of the delivery area is to expand the use of small harbours to drive economic growth through fisheries and other activities.³⁶ A set of key initiatives was established to:

- a) ensure territorial integrity;
- b) develop maritime skills;
- c) encourage the development of inclusive maritime development;
- d) develop and empower an inclusive fisheries industry;
- e) develop a small harbour economy;
- f) develop a regulatory framework conducive to fast tracking infrastructure projects.

These 14 initiatives are provided in Annexure 10.2.

The Marine and Maritime Tourism Delivery Area

This delivery area is led by the National Department of Tourism (NDT). To date, no initiatives have been made public by the Marine and Maritime Tourism Lab, although activities are believed to centre on a spatial and economic evaluation of tourism sectors in the marine and maritime domain. This sector holds the most promise for employment opportunities.

Enabling Mechanisms

Skills Development and Capacity Building

A number of skills and capacity challenges was identified in the OP-OE. The skills development and capacity building enabler is led by the Department of Higher Education and Training (DHET). The South African International Maritime Institute (SAIMI) has been appointed as the skills development delivery agent. SAIMI has in turn created five multi-stakeholder Skills Initiative Working Groups, which are aligned to the OP-OE delivery areas, to coordinate the planning of the maritime skills development initiatives and to advance a skills development strategy, framework and implementation plan (for each delivery area) for consideration by universities.

Research Technology and Innovation (RTI)

This enabling area is led by the South African Department of Science and Technology (DST). Areas of RTI within the OP-OE framework identified under this enabler include the South African Marine Research and Exploration Forum (SAMREF), the Marine Domain Awareness (MDA) nano-satellite constellation and the Marine and Antarctic Research Strategy (MARS) recently developed by OP-OE Phakisa initiatives.

Furthermore, the South African Maritime Safety Authority (SAMSA), the DST and SAIMI contracted the South African Council for Scientific and Industrial Research (CSIR) to facilitate the process of developing a National Research, Innovation and Knowledge Management Road Map for the South African Maritime Sector (the targets of which are provided in Annexure 10.3).³⁷ Lastly, South Africa, under the DST, has coordinated a national Chapter of the IORA Academic Group, with one of the thematic focus areas being the Blue Economy.

MSP, Ecosystem Service Evaluation and Ecosystem Accounting in Sustainable Governance of the Oceans

The expansion of ocean economies within limited coastal or continental shelf waters, where the majority of such expansion is occurring, has the potential to lead to inter-sectoral (or user-user) conflict and environmental impacts (user-environment conflict) and consequently to affect flows between systems, including the continuing flows of ecosystem services. The management of such conflict requires governance, defined here as an informed decision-making process for allowing trade-offs between resource-user needs and environmental requirements, while allowing for the minimisation of conflict as well as sustainability, accountability and equity.³⁸ The importance of an effective governance regime to sustainably manage living marine resources is widely acknowledged.³⁹

Many nations or authorities around the globe are turning to Marine Spatial Planning (MSP) to underpin their decision-making processes within the ocean space. MSP is defined as a public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives that are usually specified through a political process⁴⁰. Lester et al.⁴¹ define MSP as a process that consolidates multi-sectoral ocean use to inform sustainable ocean resource use. While MSP allows a spatio-temporal overview of interactions between human use sectors and the environment, the identification of conflicts arising from the interactions of use sectors requires the development of conflict / compatibility matrices through extensive stakeholder engagement. For example, while many recreational uses are compatible, shark-cage diving and recreational beach usage would be considered as conflicting use. Overlaying interactions identified through the MSP process against the conflict / compatibility matrix allow for the identified interactions to be translated into potential conflicts, which will require trade-off decisions to be taken by management. As noted by Costanza,⁴² trade-offs are inherently based on values and the evaluation of ecosystem or environmental services generated or lost through interaction between sectors, and between sectors and the environment. Ecosystem and environmental service evaluation, and their associated negative externalities, and ecosystem accounting, become integral in the sustainable governance of ocean economies. Ecosystem accounting is a novel and emergent discipline that integrates ecological and biophysical data to identify and monitor changes in ecosystems, and the relationship of identified changes to economic and human activity, through ecosystem service flows.⁴³

Ecosystem service evaluation needs to be viewed through economic, environmental and social lenses, so that all three pillars of sustainability are incorporated

into a Blue Economy model. Provisioning private and public goods and services usually has an associated market value and is consequently relatively easy to value (although the relative contributions of natural, built, human and social capital require determination). The non-market public goods of regulatory or cultural services are considerably more difficult to evaluate and are often valued by proxy methodologies.

It is also considered imperative that the governance of expanding ocean economies adopt the Ecosystem Approach in conflict management within the ocean space, to ensure that natural capital is sustainably accounted for and that provisioning ecosystem and environmental service use does not compromise ocean integrity and health.

Lessons Learned and Recommendations for Other Member States to Consider in the Oceans Economy Policy Arena

Worldwide, nations and regions will increasingly turn to their ocean economy to foster the economic growth required by the burgeoning human population. Emergent ocean economy nations can gain considerable insight into the integrated coastal and ocean management of their sea-space by drawing on the experience of more established ocean economies. There are a number of important aspects of the Operation Phakisa Oceans Economy initiative that could be considered by other IORA Member States, particularly those in the Western Indian Ocean region. Many of these aspects relate to ocean governance.

1. Consolidation of Ocean Governance

Governance of multiple ocean uses is often fragmented and carried out by a number of different authorities. For example, prior to the OP-OE initiative in South Africa, ocean use management was spread across a number of national departments, each with its own mandate.⁴⁴ Whereas individual delivery areas of the OP-OE are still mandated to different departments, the establishment of an over-arching Ocean Secretariat and Inter-Ministerial Committee within the OP-OE MPS&G Delivery Area consolidates the ocean governance framework. Furthermore, the historic multiple management mandates of the different departments meant that there were multiple legislative instruments governing ocean management. Review of the ocean legislation will allow for the consolidation of legislative instruments. Associated with this, the drafting of a MSP Bill [B9 of 2011] and a national MSP framework under this Bill will ensure (at least on paper) that ocean governance follows an MSP

process. It is important that ecosystem service evaluation and assessment (including the assessment of negative externalities) be included in this process.

2. Capacity Development within Ocean Economies, including within Ocean Governance

The enabling mechanisms of the OP-OE initiative mean that both human capacity development and job creation opportunities, and research, technology and innovation are advanced in the OP-OE initiative. It is imperative that governance be an informed decision-making process. Knowledge bases, skills and technological advancement are integral to the process, particularly in terms of ensuring a science-based EA to manage expanding ocean economy conflict. Both the South African National Marine and Antarctic Research Strategy (MARS) and the MPS&G development of a National Oceans and Coasts Information Management System (National – OCIMS) advance the development of knowledge and information bases for ocean governance, including earth observation technology (early warning systems) and compliance monitoring and the spatial layers required for adequate MSP.

In this regard, the significant opportunities provided by South Africa's Operation Phakisa for the development of human capacity within the Western Indian Ocean should be noted. IORA is particularly well-placed to advance the training mobility of academic and marine management practitioners, so as to optimise human and technological capacity development in ocean governance and associated tools (including decision support components). Such tools include research and knowledge development, Marine Spatial Planning (MSP), Marine Protected Areas (MPA) establishment and management, and Marine Domain Awareness (MDA) and compliance monitoring and enforcement aspects tied to MDA. It is strongly believed that common training and skills development protocols that are developed in a trans-boundary fashion will greatly facilitate the integrated and research-based Blue Economy approach to ocean governance.

3. Advancement of Research Innovation and Technology

A further initiative in the advancement of a science-based ecosystem approach to management is the recognition that a sustainable Blue Economy model requires a discovery, research and monitoring programme in SA's marine domain to allow for effective and continuous Marine Spatial Planning and the establishment of a representative MPA network. The MPS&G Delivery Area identified accelerated capacity development in the field of ocean governance as being important and thus the expansion of research and capacity development in MSP and MPA areas.

4. Enhancement of Compliance Monitoring and Enforcement

It has long been noted that legislative instruments and their associated regulations are only effective in association with adequate compliance monitoring and enforcement. Illegal and unregulated extractions may result directly in economic and employment losses, as they ignore fish catch limits and are consequently over-consumptive, while illegal effluent releases or pollution dumping activities have a significantly negative impact on marine resources. The enforcement and monitoring component of the OP-OE initiative allows for the advancement of new technologies, including nano-satellites, drones and automated video and acoustic systems for monitoring (and, to some extent, for earth observation). Associated with compliance and monitoring, the MPS&G Lab recommended that a national water quality monitoring programme be established to monitor coastal water quality as the ocean economy expands.

5. The Establishment of Marine Protected Areas

Marine Protected Areas (MPAs) play a critical role in the protection of ecosystems and marine resources. Not only do they have conservation value, but they play a critical role in marine resource and recreational use for South Africans. The OP-OE initiative identified a series of 21 potential new MPAs to cover an area of almost 5 per cent of the South African mainland Exclusive Economic Zone to ensure that all critical habitats are conserved.

6. The Use of Marine Spatial Planning and Other Decision Support Tools in Ocean Governance

The governance of expanding ocean economies requires governance in terms of trade-offs to militate against conflict. Trade-offs require evaluation and, although Marine Spatial Planning provides the extent of interactions between economic sectors, conflict matrices, ecosystem service evaluation and ecosystem accounting provide further decision support tools to evaluate sectors and their externalities, and allow for scenario comparisons across provisioning, regulatory and cultural ecosystem services. Resultant scenarios need to be evaluated equally from economic, environmental and social perspectives.

7. Stakeholder Engagement

A particularly encouraging area of the OP-OE initiative has been the extent of stakeholder engagement in some areas (e.g. aquaculture), including at grass-roots

level. However, there is a need for increased stakeholder engagement at other levels, particularly in the MSP arena as stakeholder engagement is considered an integral pillar of the MSP process. Besides ensuring the participation of communities affected by developments, government should also engage with the private sector, academia and non-governmental organisations operating in the sector.

Conclusion

It is a moot point that ocean economies will expand throughout the Indian Ocean Rim region. In that case, and in the light of the United Nations' SDGs, regional imperatives, such as those of the IORA Blue Economy initiatives, and the Blue Economy goals of the African Union, it is essential that an ecosystem-based approach be followed, including Marine Spatial Planning, a full evaluation of ecosystem services and their associated externalities and trade-off decision-making within a sustainable ocean-governance model.

Regional mid-term and long-term cooperation and collaborations between Member States on Blue Economy management and planning is an area that would be of considerable mutual benefit to IORA Member States. It is hoped that the South African experience with Operation Phakisa will assist other Member States in planning their approaches to the Blue Economy and, of course, that South Africa will learn from Member States that are more advanced in terms of the development of Blue Economy initiatives, as part of a process of mutually beneficial learning, knowledge sharing and skills transfer.

The Forty-Seven Initiatives Identified within the Initial Four Delivery Area Labs of Operation Phakisa

Marine Transport and Manufacturing Delivery Area

Infrastructure and Operations

1. Create a supportive funding and revenue model
2. Establish purpose-built oil and gas port infrastructure by appointing Facility Operators – Saldanha Bay
3. Align on implementation of government policy
4. Prioritise Transnet and TNPA funding allocation towards marine manufacturing
5. Maintain and refurbish existing facilities
6. Unlock investment in new and existing port facilities
7. Implement Strategic Prioritised Project – Richards Bay
8. Implement Strategic Prioritised Projects – East London

Skills and Capacity Building

9. Train 2,550 TVET college graduates on an 18-month workplace-based Experiential Learner Programme in scarce and critical trades over the 5-year period
10. Create dedicated occupational teams for the MTM sector (professional, trades, operators and seafarers)
11. Establish trade RPL, CBMT or Centres of Specialisation in Saldanha Bay and Richards Bay
12. Train 18,172 learners as artisans, semi-skilled workers and professionals over the next 5 years
13. Increase use of the ESSA system and targeted career awareness services, as a high value recruitment tool for MTM
14. Increase capacity to develop skills for ~1,200 ratings and ~720 officers per year

Market Growth

15. Create and implement a public procurement and localisation programme
16. Develop a strategic marketing campaign and value proposition for target markets
17. Propose the inclusion of a preferential procurement clause in the African Maritime Charter
18. Support a local registry of vessels through incentives and legislation to promote the use of SA-flagged ships for cargo and coastal operations (based on the United Nations Conference on Trade and Development and African Maritime Charter guidelines)

Oil and Gas Delivery Area

Infrastructure

1. Develop phased gas pipeline network

Environment

2. Conduct joint industry/government emergency response drills
3. Operationalise IOPC1 Funds
4. Exploit broader research opportunities presented by offshore oil and gas exploration

Localisation of Supply Chain

5. Develop/implement local content roadmap

Capability Development

6. Develop/implement skills strategy roadmap
7. Develop capability for subsurface research and data gathering

Institutions

8. Build end-to-end institutional structure
9. Enhance environmental governance capacity of the oil and gas regulator
10. Promote awareness of oil and gas industry

Legislative

11. Provide legislative clarity and stability

Aquaculture Delivery Area

1. Selection and implementation of 24 projects
2. Legislative reform to promote aquaculture development
3. Establishment of an Inter-Departmental Authorisations Committee
4. Establishment of a globally recognised monitoring and certification system
5. Establishment of an Aquaculture Development Fund
6. Capacity building for support services
7. Coordination of industry-wide marketing efforts
8. Preferential procurement of aquaculture products

Marine Protection Services and Governance Delivery Area

Integrated Framework and Governance

1. Ministerial Committee and Secretariat to govern activities

2. Enhancement of legislation for the ICOM Act or Oceans Act
3. Review of ocean-related legislation
4. Accelerated capacity-building intervention in ocean governance

Ocean Protection

5. Enhanced and coordinated enforcement programme
6. National ocean and coastal information system and extending earth observation capacity
7. National ocean and coastal water quality monitoring programme
8. Creation of an MPA representative network
9. MPA/MSP discovery, research and monitoring programme

Marine Spatial Planning (MSP)

10. MSP process

Annexure 10.2

The 14 Initiatives Identified within the Small Harbour Development Delivery Area of Operation Phakisa

Small Harbour Development Delivery Area

Small Harbour Development Unit

1. Establish Unit under DPW
2. Capacitate the Unit for small harbour operational management support
3. Constitute an Inter-governmental Task Team
4. Establish a Small Harbour Development Authority

Consolidate and Implement Harbour Development Vision

5. Implement proclaimed harbour Spatial and Economic Development Framework (SEDF) recommendations
6. Generate SEDFs for un-proclaimed small harbours
7. Implement SEDFs for un-proclaimed small harbours
8. Integrate small harbours with coastal integrity

Harbour-Related Skills Development

9. Prepare scarce skills development plan
10. Train technical and management staff
11. Implement a career development plan

Sustainable Development Approach

- 12. Prepare a business plan
- 13. Prepare environmental guidelines
- 14. Implement inclusive development initiatives.

Annexure 10.3

Target Objectives of the Research, Innovation and Knowledge Management Road Map for the South African Maritime Sector

Objective	Target
1	We have a maritime culture and recognise and learn from our maritime history
2	We have an enabling governance framework for the maritime sector
3	We have an efficient system of coordination, collaborating and knowledge sharing and have taken measures to reduce red tape in order to promote investment and development
4	We utilise our resources sustainably and protect our natural resources in the EEZ
5	We have a research, innovation and knowledge management system that is relevant, well-functioning, targeted and multi-disciplinary
6	We have structured financing of initiatives in the sector and sustained maritime economic growth
7	We prioritise safety and security and military protection within and beyond our EEZ
8	We have national, regional and international presence and recognition

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Fisheries and Aquaculture Employment Generation in the Indian Ocean Region

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It is well known that the ocean provides significant benefits and is an integral part of the Earth's ecosystem. Ocean economy sectors such as fin-fish, shell fish resources, coastal tourism, the shipping industry, marine biotechnology, minerals, mining and renewable energy play an important role in the economy of coastal countries. At present, global ocean economic activity is in the order of US\$3-5 trillion, and the world is competing to tap ocean resources for economic growth and employment.¹

The Indian Ocean – third largest of the world's five oceans – harbours a great diversity of marine ecosystems and fisheries, all with substantial economic value. Of all the benefits the oceans bring, fisheries and aquaculture are perhaps the most important for food security and livelihoods. The job potential of fisheries and aquaculture has grown faster than employment in traditional agriculture during the last few decades. Fish landing centres, with the associated processing facilities, and aquaculture, provide remarkable employment and monetary benefits to coastal and small island developing states (SIDs).

Today's challenges, to feed and employ an increasing population in a scenario of climate change and aquatic ecosystem pollution, could be overcome by developing the fisheries and aquaculture sectors of the Indian Ocean region. The aim of this chapter is to identify sub-sectors of the fisheries and aquaculture industry for employment generation in the region, in the context of current challenges such as over-fishing, climate change, and pollution of marine ecosystems.

According to the OECD, oceans contribute US\$1.5 trillion annually in value-added to the overall economy. The FAO estimates that fisheries and aquaculture assure the livelihoods of 10-12 per cent of the world's population with more than 90 percent of those employed by capture fisheries working in small-scale operations in developing countries. In 2014, fisheries produced roughly 167 million

tons of fish and generated over US\$148 billion in exports, while securing access to nutrition for billions of people and accounting for 17 per cent of total global animal protein – even more in poor countries.²

The Indian Ocean is bounded by: Asia to the north; Africa to the west; the Malay Peninsula, Sunday Islands, and Australia to the east; and Antarctica to the south. The world's busiest sea routes run through the Indian Ocean, and 40 per cent of the world's offshore oil is produced in the Indian Ocean. Sandy shore heavy minerals, and offshore deposits, are actively exploited by bordering countries, such as India, South Africa, Indonesia, Sri Lanka and Thailand. Large populations, in 47 countries located around the Indian Ocean depend predominantly on oceanic resources. In order to better understand the potential of both natural fisheries and farmed aquaculture to generate employment in the Indian Ocean Rim (IOR), let us first discuss the world's natural fisheries.

World fisheries

Fish provide primary animal protein to nearly 20 per cent of the world's population.³ The contribution that coastal fishing can make to a nation's economy of course depends on the fish resources that coast contains. If we look at the inland waters of the world (Table 11.1), there was about 11.9 million tonnes of capture fish production in 2014. This indicates an increase of 37 per cent on the preceding decade.⁴

Table 11.1: *World fisheries and aquaculture production (million tonnes)*⁵

	2012	2013	2014
Capture Production			
Inland	11.6	11.7	11.9
Marine	79.7	81.0	81.5
Total capture	91.3	92.7	93.4
Aquaculture			
Inland	42.0	44.8	47.1
Marine	24.4	25.5	26.7

Thirteen countries increased their fish catch by more than 100 000 tonnes from 2013 to 2014. Remarkable fish production was recorded by China, Indonesia and

Myanmar (in Asia), Norway in Europe, and Chile and Peru in South America. During the last 20 years Indonesia and Myanmar have reported continuous increases in their marine fish production.⁶

Sixteen countries have an annual fresh water fish catch of more than 200 000 tonnes. This represents 80 per cent of the global fish catch. Tanzania, Egypt, the Democratic Republic of Congo, and the Russian Federation show healthy fish catching numbers, but other countries, such as Brazil, report depleted catches of inland fish. Factors like pollution and deterioration of fresh water bodies are responsible for reduced fish catches. Furthermore, over-fishing due to limited distribution also contributed to the low fish catch in Brazil.

At present, approximately five million people are working in the European Union ocean economy, which contributes around 550 billion Euros to global wealth. Norway exports around 37 million 'seafood meals' daily.⁷ These examples show that ocean-related business is expanding and contributing to the growing demand for food, energy and medicine all over the world. The commercial ocean industry is global and innovative, and it has a bright future. Indian Ocean region countries are expected to benefit from further development of these industries, to the benefit of the entire world.

Global aquaculture

In 2014 worldwide aquaculture produced 73.8 million tonnes of fish to the value of US\$160.2 billion. This included US\$99.2 billion in fin-fish production, US\$19 billion in molluscs (16.1 million tonnes), US\$36.2 billion in crustaceans (6.9 million tonnes), and US\$3.7 billion in other aquatic animals, including frogs (7.3 million tonnes).⁸

In 2014, total fish production from both natural fisheries and aquaculture was at 44.1 per cent. This production increased from 42.1 per cent in 2012, and 31.1 per cent in 2004. Although an increase in total fish production was recorded for most continents, in Oceania, the trend decreased over the past three years. Moreover, China, India, Vietnam, Bangladesh and Egypt, which together share a large percentage of the world's population, have shown more aquaculture production than fish caught from natural aquatic sources. From 2005 to 2014, a 5.8 per cent per year growth in aqua-cultured fish production was observed, compared to 7.2 per cent in the period 1995-2004.⁹ As far as fresh water is concerned, aquaculture systems showed a 65 per cent increase from 2005 to 2014. In addition to fish farming, aquatic plant farming is also popular and is practised in 50 countries. A total of 27.3 million tonnes of aquatic plants are harvested from aquaculture farms.¹⁰ Aquatic plant farming has expanded at a rate of eight per cent per year over the

past decade (2004-2014), up from 6.2 per cent per year over the previous decade. This indicates that the prospects for the aquaculture sector, at global as well as national level, are encouraging.

Fisheries and fish farmers

According to the United Nations Food and Agriculture Organisation (FAO),¹¹ 56.6 million people around the world were involved with fish catching and fish farming during 2014. Of these, 36 per cent were involved on a full-time basis and 23 per cent on a part-time basis; the remainder were occasional fishers of unspecified status. 2014 was the first time since 2010 that total employment in fisheries and aquaculture remained stagnant. Because of over-fishing, pollution and climate change, total employment in the capture fishery sector seems to be decreasing.¹² However, in the aquaculture sector employment is found to be stable. Employment in capture fisheries decreased from 83 per cent in 1990 to 67 per cent in 2014. Whereas, an increase of 17-33 per cent was noted in aquaculture during the same period. It has been reported that 84 per cent of those working in fishery and aquaculture are in Asia, followed by Africa (10 per cent) and Latin America (4 per cent).¹³ Innovative measures are required to arrest the declining employment trend in fisheries.

The economic significance of fisheries

Some 10-12 per cent of the global population depend on fisheries and aquaculture for their livelihood. In developing countries, the majority of those engaged in fishing and aquaculture are employed in small scale operations. Overall, clean marine and freshwater ecosystems are obligatory for economic development.^{14,15}

Fisheries management in the Indian Ocean region

The IOR region is home to about 2.6 billion people. All IOR countries are interested in availing themselves of the benefits of the Blue Economy. One of the most important tasks, if countries are to reap the benefits of the Blue Economy, is the creation of jobs in fisheries and aquaculture for the youth.

Fishing is a valuable resource in the IOR. It has been reported that in 1950 marine capture fish production along the Indian Ocean was 900 000 tonnes, which had increased to 11.3 million tonnes by 2010 (FAO 2016) around 14.6 per cent of total global fish caught.¹⁶ Populations along the Indian Ocean depend on fish for their animal protein, and fish also support their livelihoods. The need is to maintain and grow sustainable fishing and fisheries to support the food demands of an estimated 9.7 billion people by 2050.¹⁷

Fish consumption has increased from 9.9 kg per person in the 1960s to 20 kg per person per annum in 2014.¹⁸ In 2014 the global fish catch, including fresh water, was 93.4 million tonnes. In developing countries, most fish production comes from natural aquatic resources, rather than farmed aquaculture; but, in the near future, aquaculture will probably be the fastest growing food-producing sector and will account for nearly 50 per cent of the world's fish.

Employment generation in fisheries in the IOR and elsewhere

In 2013, around 37.96 million people were working in the fishery sector, and some 18.8 million were engaged in aquaculture. In 2014, of 4.6 million fishing vessels reported to be operating globally (90 per cent in Asia and Africa), only 64 000 were twenty-four metres in length, or longer.¹⁹

Fish and allied products constitute one per cent of all world merchandise trade in value terms, which is more than nine percent of total agricultural exports. In 2014, developing countries exported US\$80 billion in fishery products, higher net trade revenue than meat, tobacco, rice and sugar combined. Directly and indirectly 500 million people from the developing world depend on fisheries and aquaculture.²⁰

The fishery industry involves the catching, processing, marketing and conservation of fish. The academic subject of 'fisheries science' studies the management and analysis of fisheries. Fishery often depends on the availability of living resources in the exclusive economic zone of a specific country. Over the last three decades both natural fishing and fish farming have grown faster than job generation in land-based agriculture.

In Asia, fishers and fish farmers represent the major percentage of the population of China, India, Indonesia and Vietnam (84 per cent in 1990), whereas Africa and South America can only claim nine and 2.3 per cent, respectively. Indonesia records six million fishers and fish farmers, which is more than jobs reported in textiles and apparel, the nation's 'most popular' sector. Secondary sectors such as fish vessel construction and maintenance, fish net production, and fish processing, also create jobs for coastal communities.

The FAO (2016) reports around 1.3 million fishing vessels with decks, and 2.8 million simple vessels (mostly without motor systems).

Employment generation in fisheries

Marine fishery and related industries offer jobs to native and foreigner workers in 144 countries around the globe, particularly in developing nations. At present

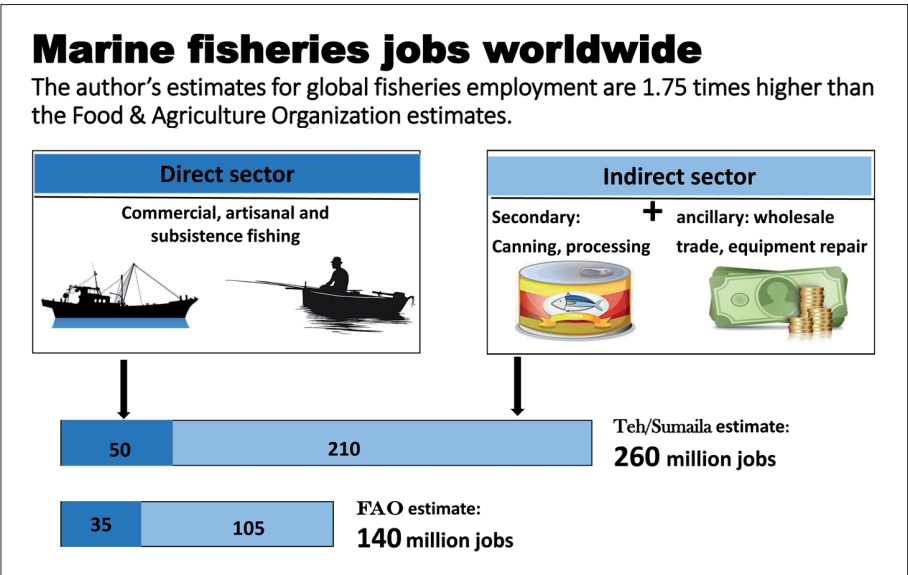
employment in aquaculture is steadily increasing in developing nations. However, a decreasing trend in fishery employment is reported in developed nations. In Japan and Norway, for example, numbers have plummeted since 1970 (by approximately 60 and 40 per cent, respectively).²¹ Teh and Sumaila²² have reported more or less the same number of people working in the sector of marine fisheries.

Table 11.2: *Global Marine Fisheries Employment (thousands)*²³

Region	Direct	Indirect	Total employment
European Union	800 + 71	1 700 + 150	2 500 + 230
Asia	40 000 + 3 100	190 000 + 15 000	230 000 + 16000
Africa	3 000 + 150	14 000 + 770	18 000 + 910
South America	1 700 + 330	3 900 + 440	5 600 + 710
Oceania	710 + 130	160 + 20	670 + 130
North and Central America	3 000 + 230	2 300 + 170	5 400 + 400

Figure 11.1 indicates about 260 million people were employed globally in marine fisheries, including full and part-time jobs. The figure further shows 1.75 times greater marine fishery jobs than reported by the FAO.

Figure 11.1: *Marine Fisheries Jobs Worldwide*²⁴



Fisheries and aquaculture

*An Indian case study*²⁵

India is endowed with a coastline 8 118 km, and an exclusive economic zone covering 2 million km² including 530 000 km² of continental shelf. Approximately 20 per cent of Indians inhabit the west and east coasts, with a large proportion based in the coastal metropolitan cities of Mumbai, Chennai and Kolkata. The Indian coastline is home to a variety of ecosystems, such as salt marshes, mud flats, estuaries, lagoons, creeks, mangroves, coral reefs, and sea grasses. These ecosystems harbour unique and rich biodiversity, including invertebrates, corals, fish, turtles, sea snakes, mammals, sea grass and abundant seaweed types.

Fisheries play a vital role in India's overall development, with about 1.9 million people reliant on fishing, while others are engaged in the processing, sale and handling of seafood products. Coastal fishing employs a million people full-time, and the post-harvest fisheries employ another 1.2 million. Marine capture fisheries production is greater in waters off the west coast of India due to the large continental shelf in the Arabian Sea. About 80 000 mechanised fishing vessels, along with about 75 000 motorised fishing boats, and around 50 000 traditional non-motorised fishing craft, are currently in use. Marine fisheries account for about 35 per cent of total fishery output, and aquaculture production around 65 per cent of overall output.²⁶

The seas around India are home to more than 10 per cent of the world's fish varieties. Since independence in 1947, fresh and marine water fishing in India has been a valuable economic sector, and it has a lot of potential to become even more valuable in the near future. Between 2012 and 2013, India recorded fish production of 9.6 million tonnes, which represents a significant increase on the figure recorded in 1950/1951, for example. At present, India ranks second in global fish production, and it is realising annual growth of 7.5 per cent.²⁷ Similarly, India's foreign exchange earnings (US\$3.51 billion in 2012/2013) from the fish industry show its significance to both India's economy and the food security of its people.

Globally India ranks second in aquaculture production. In India aquaculture was practised initially as a backyard activity, but today is commercially practised in most states. Fish and shellfish farming (incorporating fresh, brackish and marine water fish farming) have shown growth rates of six to seven per cent. Many fish farming communities, in cooperation with various central and state government agencies, are making efforts to boost aquaculture.

Institutions like the Central Institute of Freshwater Aquaculture, Central institute of Brackish Water Aquaculture, the National Fisheries Development Board (NFDB), the Indian Council of Agricultural Research, and the Central

Marine Fisheries Research Institute are also implementing various programmes for fish farmers to boost aquaculture in India. Similarly, fisheries departments in every state in India run various schemes to improve aquaculture in their respective states. The NFDB runs various schemes to promote fishing and fisheries, including building harbours, ice making factories, fish landing centres, mobile delivery vans, cold storage facilities, auction halls and fish markets. As part of the effort to protect marine resource stocks and encourage sustainable fishing, the government enforces seasonal fishing bans on important fishing grounds, and has also tightened the process of issuing fishing boat licenses, so as to prevent the national fleet from growing any further for the moment.

The share in total fish production of inland fisheries and aquaculture has gone up from 46 per cent in the 1980s to over 85 per cent in recent years. Bumper production of 4.03 million tonnes of fresh water cultured fish was recorded in 2010, reflecting a mean annual growth rate of six per cent since 1980. A major portion of aquaculture production is from inland fish farming. Bulk production of fresh water carp, catfish and tilapia is undertaken in most states.

Similarly, in the last decade, farming of giant tiger prawns (*Penaeus monodon*) was also practised on a large scale in all states. However, due to problems with epidemic bacterial and viral diseases on *P. Monodon*, farmers have now switched to farming *Penaeus vannamei*, and the Indian Council of Agricultural Research (ICAR) reports that an annual fish production of 2 900 kg/hectare was achieved by many fish farmers.²⁸ Through the adoption of modern techniques such as induced breeding and polyculture, high annual production of 8 to 12 tonnes per year was also recorded.²⁹

Currently, around 90 per cent of fresh water fish culture production is sold on the local market. In the hilly area states of Kashmir and Uttarakhand, efforts are also in progress to popularise the farming of trout and mahseer. Many central and state government fisheries departments have also taken initiatives to help fish farmers to increase their harvest and economic stability.

Fresh-water prawn farming has received attention in the last two decades owing to high consumer demand. The giant river prawn, *Macrobrachium rosenbergii*, the largest and fastest growing prawn species, is cultured either under monoculture or polyculture with major carp. Seaweed and mussels production has grown as a commercial activity, and for some fish species, like seabass and cobia, on an experimental basis, so as to standardise the technology. Over 30 species of genus *Macrobrachium* have been reported in Indian waters and *M. rosenbergii*, *M. Malcomsonii* and *M. Gangeticum* have been found suitable for culture. However, only *M. rosenbergii* is cultured on a large scale in coastal states.

Brackish water aquaculture in India has a long history of traditional practice in the bheries of West Bengal and the rice fields of Kerala. Scientific farm management

was initiated in the early 1990s and developed the Brackish water culture into a major export-oriented sector in subsequent years. However, commercial farming was confined to a single commodity, shrimp, *Penaeus monodon*, and *Penaeus vannamei*, owing to their high export potential.

India has an estimated total estuarine area of 3.9 million hectares, of which 1.2 million hectares of coastal salt-affected lands have been identified as potentially suitable for brackish water shrimp farming. Of this, about 15 per cent has been put to aquaculture use. It is estimated that there are about nine million hectares of salt-affected land in the hot semi-arid and arid eco-region of the northern plains and central highlands in the states of Haryana, Rajasthan, Uttar Pradesh, Maharashtra and Gujarat, which contain surface and sub-soil saline water.

Moreover, the ornamental fish culture in all states and the seaweed culture in coastal states is gaining momentum, and many fish farmers are looking at these as additional industries for more earnings. Nevertheless, India's share of the global ornamental fishery market is very meagre.

Many research institutes under the leadership of the Indian Council of Agricultural Research are trying their best to help boost fishery and aquaculture production in all states. Further, many schemes to upgrade the social and economic status of fish farmers all over India are also being implemented. Thirty-three states in India have established state fishery departments to implement ICAR schemes and to enhance the fishery and aquaculture industry.

After independence in India, with the growth of fishery and aquaculture, the job market also increased proportionately. Trained and untrained colleagues are employed in aquaculture. In all coastal states the ancestral work of fishing is passed on from generation to generation. However, nowadays many fishermen and women educate their children, for better prospects in jobs and life.

India has many freshwater ecosystems like rivers, lakes and dams, and these have great potential for creating new jobs. At present only 40 per cent of the available fresh water resources are used, mostly for carp and river water prawn culture. The case of brackish and marine water prawn culture is similar, and only 15 per cent of the available area is currently being utilised. Moreover, recent technologies, if adopted on a cooperative basis, can also increase jobs on a large scale. Many fish farmers still use traditional methods for prawn farming, and these should be changed to modern methods.

Development in the following culture systems must be undertaken in India if new jobs are to be generated:

- *Ornamental fish*: States like Nagaland and Manipur, in particular, have a varied biodiversity of ornamental fish. However, hardly any ornamental fish culture is practised in these, and other, states. Ornamental fish culture is only done on a

small, local basis; therefore, it would be helpful to devise a national programme for ornamental fish culture.

- *Inter-tidal molluscs*: The west and east coasts of India harbour a diversity of bivalves and gastropods. The fish market mostly depends on natural catches for their supply of these molluscs. But at present, due to pollution and urbanisation in coastal areas, molluscan density is decreasing rapidly. The only culturing of mussels and oysters is done off rafts in limited areas off the east coast. However, culturing of gastropods having high nutritious value has been neglected. It is important to develop bivalve and gastropod culturing on a large scale, as this would provide employment and also earn foreign exchange for India.
- *Algae*: A variety of seaweed types, which have many applications, are available. But today only small areas are cultivated. This should be up scaled to fulfil market demand.
- *Sea cucumber*: In spite of the availability of echinoderms like sea cucumber (which has great export potential) on the west and east coasts, hardly any efforts are in progress to develop culture system of sea cucumbers.

*A Mauritius case study*³⁰

Mauritius has a shelf area of 3 046 km², a coastline of 276 km, and an exclusive economic zone) of 1.9 million km², co-managed with the Republic of Seychelles. The coastal zone, including the outer islands of Mauritius, has rich fishing grounds. There are 5 100 people involved in fish catching and farming and 6 800 engaged in secondary sectors. Fishermen and women use a variety of gear to fish in the lagoons and reef areas. The fish catch is sold daily at 61 fish markets, from where it is distributed to other districts. Lethrinids, scarids, sigannids and mullets are the major fish species caught and sold in the market. Around 3 000 fishers are engaged in artisanal fishery. More than 1 898 fishing vessels have been reported at the main island, and 900 in Rodriguez. On average, an artisanal fisher sells around 4 kg fish in the market daily. The Mauritian seafood industry possesses transport, cold storage, cleaning, processing and sale facilities, located in various parts of the country. Facilities for the export of quality fish as per the demand of other countries are also provided to fishers.

Processed tuna and other fish products in various forms are sold in local markets, as well as exported to the UK, Italy, Spain, the Netherlands, France, Japan and Belgium. The seafood processing industry has generated 6 000 direct and 10 000 indirect jobs (created from ancillary services in Mauritius). In 2015, exports stood at 9.5 billion rupees.

Both the natural fish catch and farmed fish are mostly consumed locally. However, Princes Tuna Mauritius (PTM), a canning factory employing around 2 000

workers, exports over 50 000 tonnes of canned tuna per annum to European countries.

Although plenty of fresh water reservoirs and coastal zones are available, aquaculture is not well-developed in Mauritius. The clean neritic waters of the continental shelf around Mauritius have great potential to develop cage culture, which can be helpful in generating jobs as well as foreign exchange. Barring a few experimental farms, sea weed culture, which can be looked upon as a source of employment generation for coastal communities, is also neglected. Molluscs like octopus are plentiful around Rodriguez Island, but may become a rare species in the near future, due to over-fishing. It is therefore essential to develop a programme of octopus culture on a national level. Further, the density and diversity of echinoderm like sea cucumber is rich around Mauritius. Farming of sea cucumber will not only generate jobs but can also earn foreign exchange for the nation.

In short, if Mauritius focuses on the farming of molluscs (including bivalve), mussels, oysters, octopus and sea cucumber, many jobs can be created in the near future.

Measures to strengthen fisheries and aquaculture in the IOR

In many Asian countries, including IORA countries, most people working in the fisheries and aquaculture sector are not well-educated or informed, as it is laborious work. However, efforts are being taken to educate the youth by opening fishery schools and colleges. Short duration courses are also implemented for fishermen and women by government, and non-governmental agencies. But there is still a need to accelerate the growth of infrastructure, which should create many jobs in this growing sector. Job creation in the fisheries and aquaculture sector may broadly include the following:

a) Developing fishing ports to help rural fishing communities make progress

In most IORA countries ports are constructed for commercial ships, which occupy most of the port space. Small fishing boats are not given space at the ports. If special fishing ports were constructed, indirect and direct employment in fisheries would be boosted.

The following measures could also be implemented for job generation:

- The construction of portal sites for rural village fishing tourism, to further encourage resident-led development of rural village experience programmes, and

to develop rural fishing villages into venues for both tourism and fisheries and so bring greater economic benefit to the local community.

- The creation of value by developing fishing ports into multi-purpose facilities for fisheries, tourism and cultural activities.
- The building of healthcare service networks for rural fishing communities; the expansion of welfare programs for fishermen and women operating small fishing boats, and for the children of fishermen and women killed in marine accidents; the implementation of detailed, viable plans for disaster restoration and pertinent support, and the improvement of insurance systems.
- The expansion of the target group eligible for income compensation programs for fishing households with unfavourable conditions.
- Better management of the aquaculture industry and marine resources.
- The implementation of technology intensive, ecologically responsible farming techniques, by forming multi-species production complexes, developing vaccines containing fewer antibiotics, and expanding local disease prevention centres.
- The building of portal sites for fishing vessel price and transaction information, thus facilitating boat trading between those wishing to enter the industry and those wishing to exit.
- The utilisation of coastal marine farms and eco-friendly inland water farms as eco-tourism resources, and the provision of aid to help them strengthen their footholds and contribute to local economies.
- Focussing on the protection and conservation of natural resources by cultivating species, releasing fish, and restoring spawning and inhabitable sites through mangrove plantation in coastal zones.
- The support of fishing communities using regulations for the protection of fishing grounds and resources; and the uniform implementation of these regulations across the nation, to further encourage fishing communities to abide by total allowable catch.

b) Fostering new industries using biotechnology

Marine biotechnology is an upcoming frontier for boosting the Blue Economy. Many marine organisms are screened for bio-prospecting and are collected from every niche area of the marine ecosystem. Currently, collection of animals is done by marine scientists. However, fishermen and women could be trained to collect samples for bioprospecting while they are out at sea. This could open new avenues of employment to fishing communities, such as being actively involved in the following:

- The development of new medicines and new materials using marine living organisms.
- The development of advanced marine product breeds by harnessing fisheries technology and biotechnology, and the improvement of fishing ground environments and aquatic ecosystems by utilising sea water purifying plants.
- The establishment of effective marine life resources management systems and concomitant marine bio- information technology.
- The exploration of new information and communications technologies (ICT) and cutting-edge equipment.
- The exploration of ocean depths by developing cutting-edge ICT and robotic technologies, such as underwater mobile communications systems, robots for underwater construction, and manned submersibles that can dive to as low as 6000 meters.
- Boosting the efficiency of logistics by utilising 3D container search devices and IP-RFID-based global freight tracking devices.
- The development and distribution of advanced fisheries equipment and systems through innovative projects, and the bolstering of productivity and competitiveness of the fishing industry by reforming its inefficient structure, which currently leads to excessive energy consumption.

c) Developing eco-friendly energy sources based on environmental technology

- Secure source technologies for the production of biohydrogen, biodiesel and other marine bio-energy sources that use marine organisms such as microalgae.
- Develop technologies for large-scale CO₂ storage in geological formations of deep sea beds to address climate change and to advance into the blue ocean with less carbon footprint.
- Apply renewable energy sources to port facilities and expand the Alternative Maritime Power Supply system to minimise carbon dioxide emissions.
- Distribute biodegradable fishing nets to contribute to fish sustainability.

Along with these measures, it is vital to protect the ocean from all sources of pollution, in order to preserve fishing grounds. Problems like ocean acidification, over-fishing, and sea surface temperature rise need to be considered carefully, in order to protect fishery resources and the very future of humanity.

Need for an action plan

To implement these recommendations, an action plan must be developed by IORA. First, each member country of IORA should review the following: the present status of employment in their fishery and aquaculture sectors; the available infrastructure in terms of fish markets; the technology used for fish catching; the economic and social status of fishers in their country; the level of education and literacy among fisher folk; the status of aquatic ecosystems, that is pollution levels in seas, rivers and other fresh-water bodies; the state of fishery education imparted by schools and universities; the status of research on marine biotechnology, fishery science, aquaculture and the monitoring of water bodies; and the status of various government and non-government organisations working on the upliftment and betterment of fishing communities.

Once review on these points is ready, an action plan needs to be devised within a certain time limit. Every IORA member country can involve fisherfolk, fish farmers, fishery scientists, and economists in preparing this action plan to improve employment in the fishery sectors of their respective countries. Discussion and brainstorming among government officials of IORA countries will give proper guidance for preparing such an action plan. If an action plan is drafted by considering review of these points, it is certain that more and more jobs will be available in fishery and aquaculture sectors.

Conclusion

Although the world is focusing on fisheries and aquaculture for the generation of more jobs, climate change factors (like ocean acidification and warming, and the pollution of marine and water ecosystems) could significantly affect the production of global fisheries. The global population continues to increase and several reports have stressed the need to increase global fish production to feed the increasing population. Sustainability is key because factors such as climate change and aquatic pollution can alter both the distribution and the density of marine populations. In conclusion, proper management of capture and aquaculture fisheries is essential in the near future, if hope for the generation of more jobs in the fisheries and aquaculture sectors in the Indian Ocean region is to be kept alive.

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Oil and Gas Exploration and Production in the Indian Ocean Region

Nicole du Plessis, Juliet Hermes and Ken Findlay¹

Introduction

The offshore oil and gas resources within the Exclusive Economic Zones (EEZ) of countries adjacent to the Indian Ocean remain relatively unexplored. Land-based exploration and production (E&P) is cheaper and easier than offshore E&P, and few countries have their own economic and human capacity to conduct activities. These limitations may lead to countries requiring external investment for oil and gas E&P and, in some cases, both political and regulatory uncertainty within host countries restricts such investment. However, certain Indian Ocean Rim Association (IORA) member countries have well-developed hydrocarbon industries, including the United Arab Emirates (UAE), Indonesia, Australia, India, Malaysia and Iran; with Iran and the UAE currently being Organisation of the Petroleum Exporting Countries (OPEC) member countries.²

Countries looking towards developing their offshore oil and gas industries have various factors to consider, including:

- Foreign investment and risk – Because many developing countries in the Indian Ocean region are financially or capacity constrained they are reliant on foreign investment to conduct hydrocarbon exploration. Profit sharing on resultant finds requires negotiation, as proponent companies will enter into a profit-sharing agreement with the host country after finding adequate reserves. As the company often carries the costs of the E&P, a country may have significant risks in financial return until the company has recovered its costs. In some cases, a country may opt to have a general ‘across the board percentage’ shareholding on each project, or profits could be linked to the price of the resultant oil and/or gas. The global market price of oil and gas is consequently also a factor when

deciding to explore or start production. This is in turn determined by global reserves as well as production levels.

- A lack of national capacity – Many developing countries in the Indian Ocean region do not have the knowledge bases or human capacity for hydrocarbon E&P activities. Agreements that a company will create in-country training programmes, with the aim that nationals become a significant proportion of the hydrocarbon industry work force, may be fostered, thus potentially creating financial and employment opportunities. However, E&P activities often require a relatively skilled work force and it may take time to develop such human capacity.

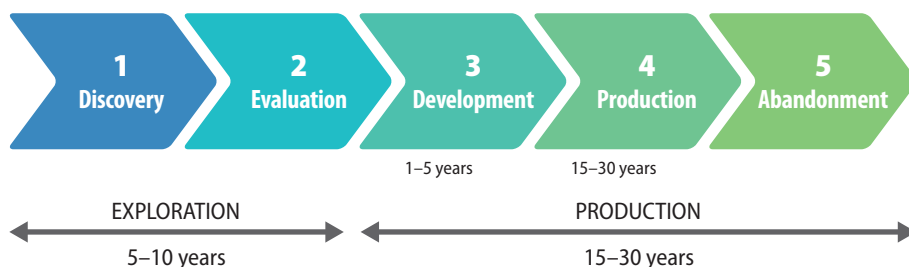
National political and regulatory environments are usually critical when foreign companies make decisions to invest in a country, as the companies require a guarantee that financial investments (whether in the form of survey data collected and analysed or built capital infrastructure) yield return on investments. With countries that already have maritime and hydrocarbon infrastructure in place (e.g. port facilities, storage facilities, pipelines), starting production activities is less expensive and faster than in countries where infrastructure requires establishment. Countries surrounding the Indian Ocean have varying levels of legislation and regulations, and a review of the existing legislation of IORA countries, so as to compare national advancements in the E&P industry, may be valuable. One of the benefits of countries prioritising mapping and analysing of their offshore environment is that they would have better options when negotiating E&P agreements, and be better placed when considering potentially space-competitive offshore activities, such as mining.

Oil and gas platforms may provide an opportunity to conduct or facilitate environmental research. Due to the high cost of operating research vessels, and the lack of research capacity in some countries, partnerships with commercial offshore operating companies are becoming a feasible way of collecting research data. Examples of such projects include the Voluntary Observing Ships (VOS) Scheme, the Ships of Opportunity Programme (SOOP),³ and the Scientific and Environmental ROV Partnership using Existing industrial Technology (SERPENT) Project, which provides scientists with time aboard oil and gas production platforms, in order to use the Remotely Operated Vehicles (ROVs) when these are not in use by the company.⁴ The SERPENT project has been very successful in providing opportunities for collecting photographic and video data in certain countries which may not have capacity for such undertakings (see the website for a full list of surveys, <http://www.serpentproject.com>). More recently, South Africa has established the South African Marine Research and Exploration Forum (SAMREF) to facilitate shipboard opportunities with various offshore industries within South African

waters. Under-explored countries could benefit from programmes such as these to further their knowledge of their marine environment.

With many oil and gas nations now having been operational for decades, there is a need to initiate, or implement, decommissioning plans in some countries. As these activities operate over many decades (Figure 12.1), and are taking place further offshore, and in deeper water, this is becoming a costly operation, and a lack of a suitable plan could be detrimental to the health of the offshore environment and ecosystems. There is therefore an opportunity for the Indian Ocean to engage in a regional response to determine the best decommissioning options.

Figure 12.1: Model of timeline indicating the average time it takes from the exploration phase to decommissioning



Source: Adapted from IFP-school

While fossil fuels will remain the largest global source of energy for the foreseeable future, there is nevertheless agreement by the global community that the use of fossil fuels is accelerating climate change.⁵ This has led to a number of initiatives to limit carbon emissions, most prominently the Paris Agreement under the United Nations Framework Convention on Climate Change, which was adopted by consensus on 12 December 2015.⁶ As of January 2017, 125 of 197 Parties to the Convention have ratified the Convention. Of the Indian Ocean Rim countries, all have signed the Convention, with 19 of the 21 Member countries having ratified it. In the light of the global agreement to limit CO₂ output, renewable energy is seen as an alternative industry for development, in conjunction with the hydrocarbon sector.

Offshore oil and gas exploration in IORA countries

The following section uses a selection of countries as case studies to discuss the development of oil and gas E&P within the Indian Ocean.

South West Indian Ocean (SWIO)

In 2013, the Agulhas-Somali Current Large Marine Ecosystem Programme (AS-CLME) released a series of reports on coastal livelihoods, and while outdated, the reports provide background information on the state of African oil and gas activities in this region.⁷ The reports indicated that most of the African countries concerned have low seismic survey coverage within their EEZs. However, recent discoveries along the northern and central coasts of Mozambique, and off Tanzania, have renewed interest in exploration along this section of the African coast. Unfortunately, these countries are limited by a lack of infrastructure and local knowledge capacity.

Most countries in this region have had some exploration activity.⁸ Mauritius and Seychelles have no known reserves, but there is some initiative to develop E&P activities in these countries.⁹ Only South Africa (oil and gas) and Tanzania (gas) have current production activities. A summary of activities for South Africa and Mozambique is presented below.

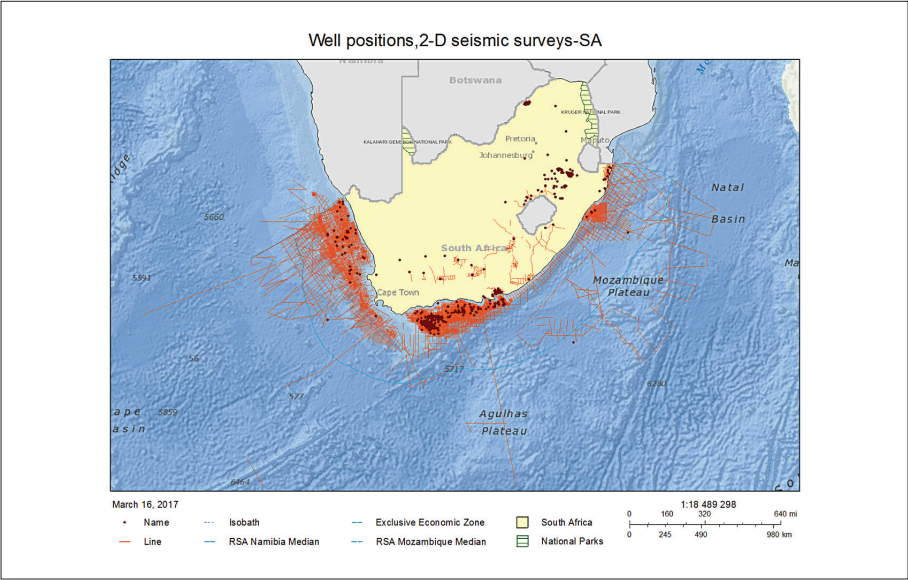
South Africa

Surveying for hydrocarbons commenced in the 1940s in South Africa.¹⁰ Offshore exploration began in 1965, with the establishment of Soekor, a state-owned company.¹¹ In 1967, a new Mining Rights Act was passed, and offshore concessions were granted to a number of international companies.¹² The first offshore well was drilled in 1969 by Superior, a foreign owned company, and saw the discovery of natural gas off the south coast.¹³ Soekor first drilled its own wells in 1973, and the first commercially viable discovery of natural gas, known as the F-A Field, was made in 1980 in the Bredasdorp Basin. This led to a production platform being built off Mossel Bay, and a Gas-to-Liquid (GTL) plant, which at the time was the largest in the world, was built onshore.

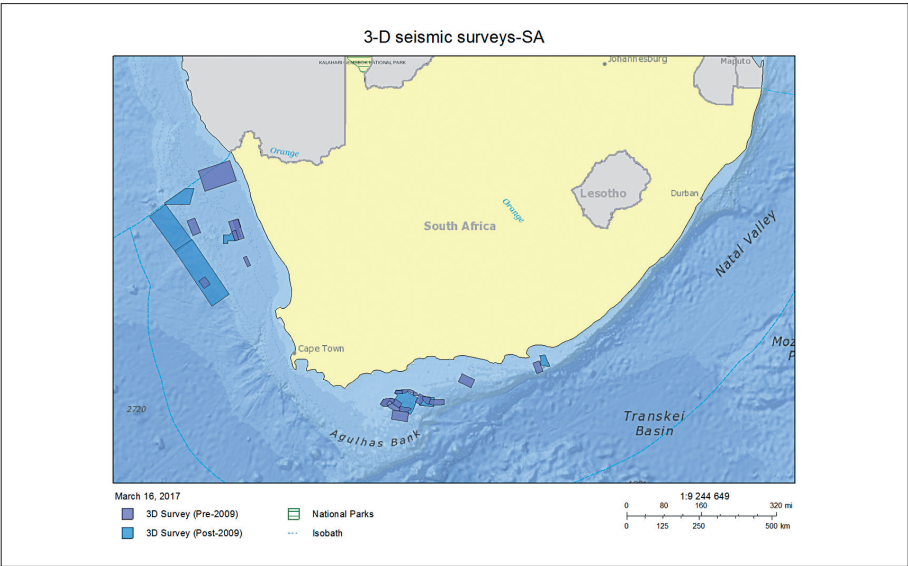
The first commercially viable oil was discovered in 1988, also off the south coast, with oil production starting in 1997. Between 1981 and 1991 some 181 exploration wells were drilled,¹⁴ which led to the discovery of several small oil and gas fields (in the Pletmos Basin, Southern Cape, there are two undeveloped gas fields, and a further six gas discoveries). There has been one oil and several gas discoveries made in the South African part of the Orange Basin on the west coast of South Africa. The most recent commercially viable discovery has been for gas along the northern section of the west coast of South Africa. Petro-SA was formed in January 2002 from the merger of three previous entities: Mossgas (PTY) Limited, Soekor (PTY) Limited, and parts of the Strategic Fuel Fund Association.¹⁵ Petro-SA is still the only company with production activities in South Africa, which occur off Mossel Bay.

SA has limited seismic survey coverage within its EEZ, with most surveys occurring off the west and south coasts (Map 12.1 and 12.2). There is also a need for new 2-D and 3-D surveys and reprocessing of data with newer methods.

Map 12.1: Map of South Africa indicating wellhead position (brown circles) and 2-D seismic surveys (brown lines)¹⁶



Map 12.2: Map indicating the position of 3-D surveys offshore South Africa¹⁷



The Mineral and Petroleum Resources Development Act was passed in 2002 and became operational on 1 May 2004.¹⁸ South Africa established the Petroleum Agency of South Africa (PASA) in 1999 to regulate South Africa's oil and gas activities, as well as provide a central point to store the information gathered by the exploration companies.¹⁹ Prior to this, Soekor was responsible for this information. PASA is also responsible for promoting the industry abroad, and managing the Upstream Training Trust, which all operators in South Africa are obliged to contribute to and which provides funding to students in fields relevant to the industry.²⁰

In 2014 South Africa initiated a new programme, Operation Phakisa.²¹ The programme is aimed at fast-tracking the delivery of the National Development Plan (NDP Vision 2030, 2011) to advance the growth of the South African economy. South Africa is looking to develop its oil and gas industry within the scope of Operation Phakisa, unlocking the 'Economic Potential of South Africa's Oceans' (or the Oceans Economy) initiative.

Recognising that both ocean industries, as well as the need for a healthy ocean environment, need to be considered, South Africa is developing a Marine Spatial Planning programme within the Operation Phakisa framework, to expand South African knowledge of its offshore environments and ecosystems. Specifically, within Operation Phakisa's Oil and Gas Lab, the South African Marine Research and Exploration Forum (SAMREF) has been established to take advantage of possible data gathering and research opportunities that offshore oil and gas activities could present.²² Prior to SAMREF, similar projects had been implemented on an ad hoc basis. An example is the collaborative study, conducted by the South African National Biodiversity Institute (SANBI) the World Wildlife Fund (WWF) and Petro-SA, to assess benthic biodiversity around the Petro-SA production platforms off Mossel Bay (Text Box 12.1). SAMREF may be expanded to formally include offshore industries already developed in South Africa, such as fisheries, and may also include other industries such as tourism and marine transport, as they develop.

Box 12.1: *Collaboration between Petro-SA, SANBI and WWF to Assess Offshore Benthic Biodiversity on the Agulhas Bank, South Africa*²³

The offshore production platforms operated by Petro-SA (South Africa's state-owned petroleum exploration and production company) off the south coast are the only production offshore platforms in South Africa. In 2009, SANBI developed a project to assess the offshore benthic biodiversity on the Agulhas Bank, funded by Petro-SA and facilitated through the WWF. This initiative was the first science-petroleum industry collaboration of its kind in South Africa and was developed in consultation with researchers, government departments, as well as industry stakeholders representing

commercial fishing and petroleum mining. SANBI's Offshore Biodiversity Initiative (OBI) identified co-operative research with offshore industries as a potential mechanism to enhance offshore data collection to support decision making in the offshore environment. As an example, such enhanced information is used to improve spatial planning decisions for proposed offshore Marine Protected Areas. The Agulhas Bank is an important ecological area supporting several high-value commercial fisheries which occur in the vicinity of the petroleum operations.

The project had several objectives:

- to provide baseline information on colonisation of existing petroleum infrastructure by benthic invertebrates and fish on the Agulhas Bank,
- to assess whether benthic communities found on petroleum infrastructures are representative of the offshore benthic biodiversity of the Agulhas Bank,
- to identify vulnerable habitats and/or species, such as cold water coral reefs, sponge beds and other habitat-forming communities,
- to undertake a pilot study investigating potential benefits of fisheries exclusion zones associated with petroleum infrastructure,
- to detect introduced species associated with petroleum infrastructure and assess the extent of any invasive taxa,
- to assess whether untrawled soft sediment fishery exclusion areas can serve as reference areas for understanding demersal trawl impacts in unconsolidated habitats.

In support of this project, Petro-SA made available historical reports on biofouling of the production platform, and existing ROV footage of petroleum infrastructure, and also provided dedicated ROV surveying opportunities and access to saturation (SAT) divers to collect benthic invertebrate samples. Ship time to deploy fish traps and collect benthic grab samples was also made available.

The project successfully demonstrated the value of science-industry collaborations in advancing scientific knowledge and informing industry on improved environmental management strategies. The area of impact around an active wellhead was established to be minimal (± 250 m), with no detectable pollution contamination when using water-based drilling muds. An inventory of biodiversity (fish and invertebrates) associated with petroleum infrastructure suggested low representativity of species compared to those occurring in nearby natural habitats. The high potential for petroleum infrastructure to serve as a vector for the introduction of alien or invasive species was identified. A need for further research to explore suitable, future infrastructure decommissioning options was also identified.

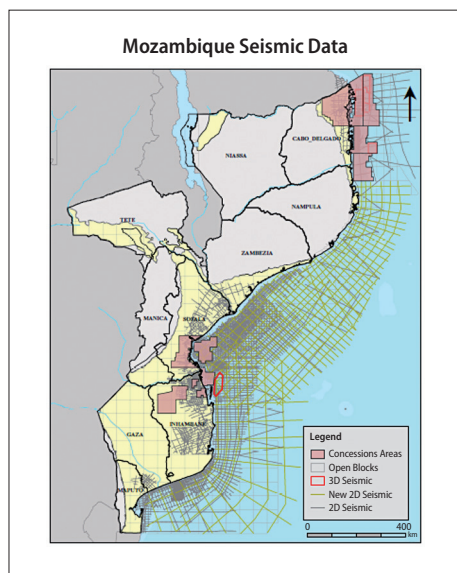
As of 2016 South Africa still does not have regulative clarity on offshore exploration and production activities, because the Mineral and Petroleum Resources Development Act 28 of 2002 amended in 2008 was written for onshore mining activities only. A new draft Mineral and Petroleum Resources Development Act should include new offshore activities.

Mozambique

Exploration of oil and gas resources first commenced in Mozambique in 1904, but this was then halted due to poor technology and a lack of funding.²⁴ Exploration was restarted in 1948, but with only limited exploration occurring offshore. Exploration activities declined again in the 1970s, due to the civil war, with new activities only commencing in the 1980s, along with the establishment of the Empresa Nacional de Hidrocarbonetos (ENH), Mozambique's national oil and gas E&P company. Formerly state owned, the company became public in 1997.²⁵ The purpose of ENH is to be 'responsible for the research, prospection, production and commercialisation of petroleum products ... and represent the State in oil operations'.²⁶ Between 1970 and 1980 only six wildcat wells (exploratory wells drilled in unproven reserve areas) were drilled, with half of these being in the offshore environment.²⁷

Mozambique has relatively high coverage of 2-D surveys (Map 12.3), but few exploration wells have been drilled (Map 12.4). A significant discovery of natural gas, of approximately 175 trillion cubic feet, was made in 2010, in the offshore Rovuma basin.²⁸ This could see Mozambique becoming the world's third largest gas producer.²⁹ The discovery of gas in the Rovuma basin has led to an increase in survey activity off Mozambique, with five licencing rounds having been held so far, and much interest shown in the northern blocks.³² However, the current low oil and gas prices have delayed the development of production facilities³³ and as yet, there are no offshore production platforms operational in Mozambique.

Map 12.3: Seismic surveys that have been conducted offshore Mozambique. Minimal 3-D surveys have occurred³⁰



Mozambique's Petroleum Law was updated in 2014, with new regulations enacted in 2015³⁴ to increase the share benefits to the Mozambican government, after the discovery of the gas reservoirs in 2010. In terms of human capacity development, the law states that the 'companies must ensure the employment and the technical-professional training of Mozambican nationals, as well as their participation in the management and in the petroleum operations'.³⁵

Northern Indian Ocean Region/ Tropical Indian Ocean Region

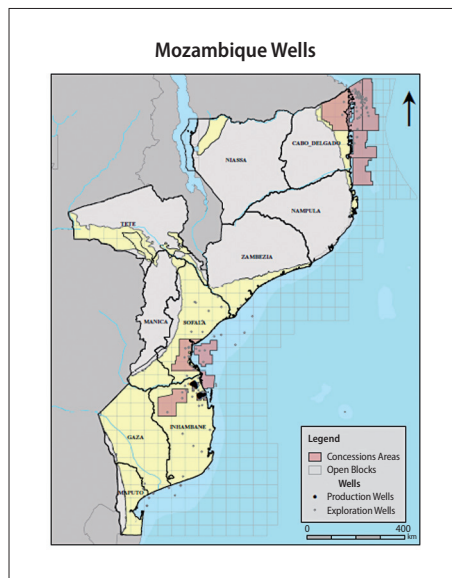
The North Indian Ocean region has a number of countries that are large oil producers, most notably the UAE, Iran and India. Sri Lanka has exploration activities occurring but as yet no offshore production has occurred.³⁶ Bangladesh had one offshore production block but it was abandoned in 2013.³⁷ A summary of activities for the UAE and Thailand is presented below.

United Arab Emirates (UAE)

The UAE has one of the world's largest oil and gas reserves³⁸ and is one of the largest producers of crude oil.³⁹ Exploration for oil and gas started in the 1920s,⁴⁰ and the first commercial offshore oil discovery was made in 1958.⁴¹ Over 90 per cent of the oil and gas reserves are located in Abu Dhabi. Dubai has the second largest production output within the emirates. Four of the other five emirates have relatively minor production operations.

There are no Federal laws governing the oil and gas industry, although a Supreme Petroleum Council, which is responsible for formulating policy,⁴² exists. Instead, each emirate has full ownership of all oil and gas resources and is responsible for regulating the industry.⁴³ The emirates grant state-owned oil and gas companies concessions, and these companies may then grant international companies minority shareholdings in a concession project company. The national oil companies, such as the Emirates National Oil Company (ENOC) and

Map 12.4: *Exploration wells drilled offshore Mozambique*³¹



the Abu Dhabi National Oil Company (ADNOC), have corporate sustainability initiatives.⁴⁴

Thailand

Onshore exploration in Thailand commenced in 1921 under the Mining Act, with operating rights granted to the Thai private sector only.⁴⁵ The first applications for offshore drilling occurred in 1964 but the first offshore well was only drilled in 1971, by Conoco, and it failed to discover any hydrocarbon deposits. The Petroleum Act and Petroleum Income Tax Act came into effect in 1971. The Thai government has amended the Petroleum Act five times and enacted 20 regulations, most dealing with safety standards.⁴⁶ The first offshore discovery was in 1973 in the Pattani Basin, and production approval was gained in 1979. Further discoveries were made in subsequent years and up to the end of 2015, 138 production areas have been approved offshore. Thailand still has a number of reserves which can be exploited (Table 12.1).

Table 12.1: *Thailand Petroleum Reserves as of the end of 2015*⁴⁷

Petroleum Reserves	Proven Reserves	Unproven Reserves	
		Probable Reserve	Possible Reserve
Natural Gas, bcf	7 304.16	5 886.62	2 746.75
Condensate, MMbbl	117.57	179.66	92.76
Crude Oil, MMbbl	218.79	185.20	127.26

Key: bcf: billion cubic feet; MMbbl: one million barrels

The Department of Mineral Fuels (DMF) sponsors a number of environmental projects as well as social and networking activities.⁴⁸ In 2015, the DMF sponsored 4 projects:

i) *Monitoring of mercury in fish tissues around production platforms*

This project was initiated in 2007 and was focused on the monitoring and surveillance of demersal fish in the water surrounding production platforms in the Gulf of Thailand.

ii) *Monitoring of seawater quality around production platforms*

In 2010 the DMF initiated a study to start sampling the mercury levels in the sea water as a complementary project to the fish sampling.

iii) *Petroleum E&P development stakeholder participatory network development, Amphoe Ko Samui and Amphoe Ko Phangan, Surat Thani*

The DMF has hosted energy education activities since 2012 and has established five 'energy and petroleum learning centres', with the department equipping such centres with tools, apparatus, and PR media dealing with Thai energy. A forum was also held for fishermen and women of Ko Sumui to discuss the development approach of coastal fishermen toward sustainability and the restoration of coconuts to Samui, once popularly known as Coconut Island.

iv) *SHE Award project*

2015 was the inaugural year for the SHE (Safety, Health, and Environment) award, which is aimed at upgrading SHE management by inspiring the petroleum operators to focus on the development of SHE systems. Eleven concessionaire sites participated – six onshore and five offshore.

Along with these environmental projects the DMF has also held various education programmes to promote development in exploration and production fields.

Decommissioning

With the offshore production industry in Thailand now close to four decades old, it has been recognised that decommissioning of production platforms will become a growing need within the next ten years.⁴⁹ Thailand is therefore looking to strengthen its laws and management practices concerning this. This will provide an opportunity to develop the decommissioning industry as the production platforms need to be removed.

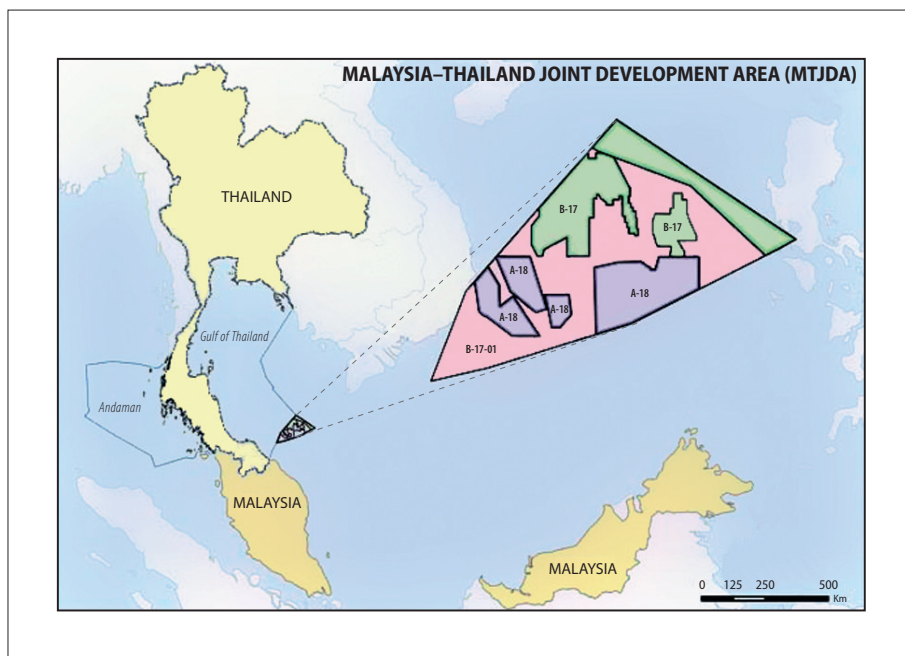
As yet, Thailand does not have any specific regulations pertaining to the decommissioning of production platforms but has spent the last few years developing these. Guidelines for decommissioning upstream installations were released in 2009 by the Petroleum Institute of Thailand (PTIT)⁵⁰ and in 2016 PTIT presented a 'Rigs to Reef' programme as a possible option when decommissioning.⁵¹

Offshore development agreement: The Malaysia-Thailand Joint Development Area

Due to overlapping claims, the governments of Thailand and Malaysia signed a development agreement in the Gulf of Thailand for an offshore area of 7 250 m² (Map 12.5).⁵² The Memorandum of Understanding (MoU) was signed in 1979 to establish joint authority for the exploitation of resources of the sea-bed in the defined areas, and led to the formation of the Malaysia-Thailand Joint Authority (MTJA), which was founded in 1992. The head office of the MTJA is in Kuala

Lumpur, Malaysia. The MTJA is a statutory body that assumes all rights and responsibilities for the two governments in regard to exploration and production. The benefits from the exploration and production activities in the joint area are shared equally between the governments of Thailand and Malaysia.

Map 12.5: Map highlighting the Malaysia-Thailand Joint Development Area⁵³



South East Indian Ocean Region

Indonesia, Malaysia and Australia are oil producing nations. Singapore has no known reserves but has established itself as a maritime country, offering various services to the international exploration and production companies.⁵⁴ A summary of Australian activities is presented below.

Australia

Due to Australia's political system, the states have jurisdiction over oil and gas activities within 3 nautical miles of the coast, with the Commonwealth having jurisdiction for the activities within the rest of the Australian EEZ, that is, to the 200 nautical mile limit.⁵⁵ Each state may enforce its own regulations within its jurisdiction, although this can be delegated to the Commonwealth.

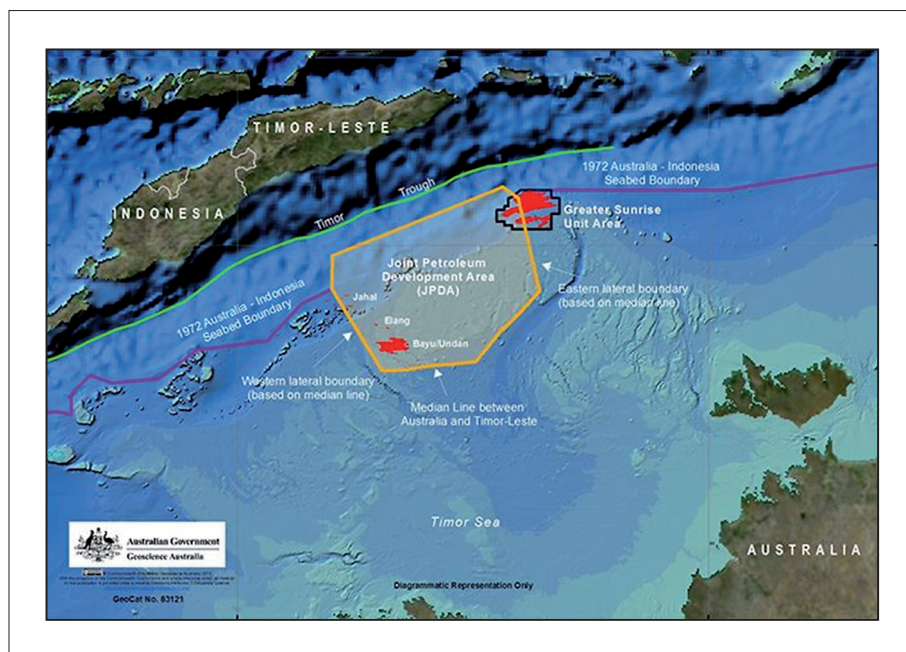
The first hydrocarbon resources were discovered in Australia in 1839, with the first offshore drilling occurring in 1907 in Albany Harbour, Western Australia.⁵⁶ The first offshore seismic survey was conducted in 1959 in the Gippsland Basin.⁵⁷ Exports of oil out of Australia peaked in the early 2000s and have been on the decline since,⁵⁸ with the nation needing to import 60 per cent of its crude oil demand.⁵⁹ Currently production is occurring in five offshore basins – the Northern Carnarvon, Bonaparte and Perth basins offshore Western Australia, and the Gippsland and Bass basins off south-eastern Australia. Due to the declining oil production Australia is keeping its regulations as favourable as possible to attract new and continued investment in its oil and gas industry.

In 2012 the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) was created to monitor compliance of offshore operations. The authority produces an annual report highlighting all relevant activities, including the number of reported spills, breaches in the safety regulations, injuries and loss of life. Australia has decommissioned a number of its smaller production platforms but consideration is also being given to determine the strategy for when larger platforms need to be decommissioned.⁶⁰ Currently this requires full removal of all infrastructures or, in some cases, Australia allows the As Low As Reasonably Possible (ALARP) approach to risks.⁶¹

Australia has a partnership with China, established in 2002,⁶² called the Australia-China Natural Gas Technology Partnership Fund. It was started to provide opportunities for training, research and knowledge transfer between the two countries in the natural gas and liquefied natural gas (LNG) industries.⁶³ Since 2005 the fund has contributed to the direct training of representatives from both countries, facilitated research, exchange visits between the countries and postgraduate funding within the LNG/natural gas fields of studies. The operations of the Fund are managed by the Secretariat which has co-directors in Beijing and Perth.⁶⁴

Offshore development agreement: Australia – Timor Leste Joint Petroleum Development Area

Australia has a Joint Petroleum Development Area (JPDA) agreement with Timor Leste (East Timor) (Map 12.6).⁶⁵ With the discovery of the Greater Sunrise Gas field (which overlaps the JPDA) the countries have signed the International Utilisation Agreement and the Treaty on Certain Maritime Arrangements which both came into force in 2007 and prevents each country from developing the Greater Sunrise Gas field unilaterally. The gas field is estimated to contain 5.1 trillion cubic feet of liquefied natural gas (LNG) and 226 million barrels of condensate. The Timor Leste offshore regulator, Autoridade Nacional do Petróleo (ANP), is currently the Designated Authority to regulate the activities within the JPDA.

Map 12.6: Map of the Australian –Timor Leste Joint Petroleum Development Area⁶⁶

Regional cooperation in a Blue Economy

There is an opportunity for countries with established hydrocarbon E&P industries to share their expertise with the countries which have only relatively recently started to invest in offshore hydrocarbon industries and do not have an adequately skilled work force to do so. A number of regional associations already exist within the region, and these can be leveraged to facilitate knowledge and skills transfer. There are also international associations which could be considered. Table 12.2 lists IORA member countries and the other organisations within the Indian Ocean region they belong to. If these regional bodies are utilised effectively these organisations can be used to transfer the knowledge and experience of established oil and gas producing countries to those countries new to the industry. This can be done by building on the relationships already present in the Indian Ocean region, such as the Australian-China Training Programme and the Corporate Responsibility programmes of various oil and gas companies.

Table 12.2: *Summary of the Regional Petroleum Associations and Regional Co-operation Programmes within the Indian Ocean Region. (Only IORA associated countries are listed, with the exception of Myanmar, whose membership is being considered.)*

Country	Association of Southeast Asian Nations (ASEAN) and ASEAN Council on Petroleum (ASCOPE)	South Asian Association for Regional Cooperation (SAARC)	Gulf Cooperation Council (GCC)	African Petroleum Producers Association (APPA)	Southern African Development Community (SADC)	African Union (AU)	International Seabed Authority (ISA)
Australia							X
Bangladesh		X					X
Comoros						X	X
India		X					X
Indonesia	X						X
Iran							
Kenya						X	X
Madagascar					X	X	X
Malaysia	X						X
Mauritius					X	X	X
Mozambique					X	X	X
Myanmar (Burma)	X						X
Oman			X				X
Seychelles					X	X	X
Singapore	X						X
Somalia						X	X
South Africa				X	X	X	X
Sri Lanka		X					X
Tanzania					X	X	X
Thailand	X						X
UAE			X				
Yemen							X

Best practice around the globe

A number of environmental concerns have been identified relating to offshore oil and gas activities.⁶⁷ Thus, there has been a move to internationally accepted guidelines and principles according to which a company may operate. Therefore, in cases where a country has weak or non-existent exploration and production regulations, companies could still be held accountable for implementing international best practices for health and safety.

A number of the rim countries depend on fisheries and tourism and other provisioning ecosystem services. As these activities require a healthy environment to operate, there may be conflict with the development of oil and gas industries. Research institutions and oil and gas companies should strive to develop new technologies and methods to improve the health and safety of the environment in which they operate. Below is a summary of possible impacts and best practice discussed by activity – exploration, production and decommissioning.

Exploration phase

Seismic surveys are the most common method to obtain information on offshore oil and gas resources. However, there have been concerns as to the effect the surveys may have on the marine fauna, especially large marine species and species which use sound for communication.⁶⁸

Seismic surveys are conducted to determine the underlying structure of the sea floor and identify possible oil and gas deposits. This is done by directing high amplitude, low frequency sound pulses at the ocean floor, usually with the use of an air gun or an array of air guns.⁶⁹ The reflected sound is then captured by receiving hydrophones and analysed by geophysicists to provide profiles of the seabed. The primary mitigation method is to give consideration to migration routes of marine animals and birds when planning operations. This can limit the timeframes and active periods allowed for operations. Within countries such as the US, and Norway, as well as in some EU countries, it is generally the case that any companies conducting seismic operations need to have observers on-board to monitor for wildlife.⁷⁰ Depending on the country, the observer may be called by a variety of terms, including Marine Mammal Observer, Protected Species Observer, Seabird Observer or Marine Wildlife Observer – all with a similar purpose.

Surveys should also adhere to doing ‘soft starts’, which is the practice of slowly increasing the volume on the air gun array instead of starting at the highest pressure. This allows any animals in the area to move away prior to being exposed to full survey sound pressures. There is, however, also the requirement that no operations may start if an animal is within a certain range of the airgun array, and operations

may have to be stopped if an animal moves into this area. In some cases Passive Acoustic Monitoring (PAM) is used, as this has the benefit that it can be used in poor visibility and at night. Specialised equipment and training are required for this.

Once possible oil and/or gas reserves have been identified from the seismic data, exploration drilling may commence. The disturbance caused by the drilling operations and the possible leaking of drilling fluid and/or discharge overboard may be potential environmental hazards.⁷¹ The possibility of an oil spill also exists. The Deepwater Horizon spill in 2010, in the Gulf of Mexico, is one of the largest recent spills to occur and the largest spill to occur in the coastal waters of the US.⁷² The US changed its operations after the spill. Prior to the spill, the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) was the regulating and safety authority within the US.⁷³ Following the spill, the Bureau was reorganised into two entities, the Bureau of Ocean Energy Management (BOEM) and the Bureau of Safety and Environment Enforcement (BSEE). The BOEM was established with the mission to 'manage development of US Outer Continental Shelf energy and mineral resources in an environmentally and economically responsible way'.⁷⁴ The Bureau is responsible for regulation and the approval of exploration and production activities. The BSEE has the mission to 'promote safety, protect the environment, and conserve resources offshore through vigorous regulatory oversight and enforcement'.⁷⁵

Other impacts to consider are those of ship and drilling noise, impacts of the artificial light on birds and turtles, and the use of explosives, which are sometimes used to create the sound pulses during survey operations (usually during shallow water surveys).⁷⁶

Box 12.2: *The Australian National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA)*

The precursor to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) was the National Offshore Petroleum Safety Authority (NOPSA), established in 2005 after a government review into the adequacy of offshore safety regulations.⁷⁷ The purpose of NOPSA was to regulate the health and safety activities of workers on offshore facilities. Due to a number of incidents offshore, both nationally and internationally (such as the Deepwater Horizon incident), the purpose of NOPSA was reassessed and NOPSEMA was established in 2012 with the purpose of regulating the health and safety, well integrity and environmental management activities for offshore oil and gas projects.

NOPSEMA is an independent regulatory authority, operating separately from the National Offshore Petroleum Titles Administrator (NOPTA), which is responsible for

the management of all petroleum titles and the Joint Authority (comprised of relevant federal and state government ministers), which is responsible for granting petroleum titles.⁷⁸ Having an independent authority overseeing health and safety (for workers and the environment) removes what can sometimes be competing mandates, i.e. increasing development of offshore oil and gas activities and reducing operating costs versus protection of critical offshore habitats and rigorous health and safety compliance.

NOPSEMA follows a transparent approach and provides on-line resources such as an annual offshore performance report, which provides information on the injuries and fatalities, incidents, inspections, assessments, investigations and enforcements that have occurred offshore, as well as information offshore oil and gas operators would need regarding health and safety plans.

Production phase

The biggest concern during production operations is mitigating against oil spills (at the production well or during transport) due to the harm it can cause to the environment.⁷⁹ There is a lot of research available on the effects of the aftermath of spills, such as the Deepwater Horizon spill and the Exxon Valdez spill which occurred off Alaska in 1989.⁸⁰

Besides this, consideration must be given to waste minimisation such as that produced by the workers on the platform; the minimisation of flaring to dispose of gas build-up (and recognising this as another usable resource); mitigating the impacts of light sources at night to prevent bird mortalities or attracting turtles if near-shore; the potential for the introduction of invasive species; and altering the environment by installing the platform, as the structure could change the local ecosystem, for example the introduction of a hard surface into a sandy-bottomed area. Platforms also have the potential to act to attract fish and/or act as a refuge, as fishing operations are not allowed within the production area; this may influence the decisions taken during the decommissioning phase.

Decommissioning phase

As mentioned in the country summaries above, there is no globally agreed upon method to decommission production operations. In many cases production may have commenced without any plans in place as to what would occur once the production fields reached their end of life or were no longer commercially viable, and decommissioning activities are very costly operations. Decommissioning does

however need to follow certain global conventions set out by the United Nations Law of the Sea (UNCLOS), the London Convention and the International Maritime Organisation (IMO).⁸¹ The latter requires that structures installed after 1 January 1998 should be designed in such a way that they could feasibly be removed, although there are some exceptions to this.

As the more established and historically active countries now or in the near future will need to decommission platforms, there may be an opportunity within IORA to facilitate the establishment of a basin wide response to this. There has already been some progress in creating a regional response, such as the Decommissioning Guidelines developed by ASCOPE⁸² (see Table 12.2 for IORA members also involved in ASCOPE and other regional bodies), and this could be built upon. Decommissioning and concurrent activities surrounding it could therefore be expanded upon in the region.

Currently there are a number of options for the decommissioning of oilfields.⁸³ For countries surrounding the North Sea which follow the OSPAR Convention, such as Norway and the UK, all material must be removed, although again there are exceptions to this.⁸⁴ There are therefore well-developed regulations in place, and a decommissioning industry exists to take care of all removal activities and the break-up of the structures on land.

The United States of America (US) has a 'Rigs to Reef' programme (R2R),⁸⁵ among other options. An R2R allows for the disposal of the platforms and/or rigs at specific sites to create artificial reefs. Malaysia also has this as a decommissioning option and has a successful example of this in the reeving of the BARAM-8, now commonly known as the Kenyalang Reef.⁸⁶

Box 12.3: *The Zero Flaring Policy in the United Arab Emirates*

The UAE has shown strong commitment to reducing carbon emissions and has the intention of generating 24 per cent of its electricity from clean energy sources by 2021.⁸⁷ One of the actions they've taken for reducing emissions has been the introduction of a policy of zero flaring during oil and gas production processes. Led by the ADNOC group of companies since the 1990's, it saw a substantial reduction in the amount of gas flared.⁸⁸ The recognition of this gas as a clean source of energy has increased both the use of the resource within the country and the development of technologies to harvest the gas.⁸⁹

Conclusion

The Indian Ocean is bordered by countries at varying stages of development within the hydrocarbon industry. As highlighted in the sections above there are already countries that are working together in shared ocean spaces and there are training programmes that have been initiated. There are also a number of sector-specific and broader focused organisations in the region and these could all be used to facilitate the establishment of a hydrocarbon industry in the Indian Ocean region. As shown, there is much overlap in membership between these organisations, which could help to facilitate partnerships as there are likely over-arching co-operative agreements already in place. Countries with little development could therefore learn from those countries that have strong regulatory practices, financial systems and environmental protection practices in place.

As an extractive industry that uses a non-renewable resource the hydrocarbon industry is not a sustainable industry but there are benefits to developing the industry while alternative, reliable low carbon or renewable energy sources and/or technologies are developed. These benefits include job creation, energy security and additional revenue to the government. A possible review of the existing legislation in countries with a well-developed hydrocarbon industry would be beneficial to determine how other countries could increase their attractiveness for investment in E&P opportunities. Decommissioning of operations is one aspect where IORA countries could work together to establish basin wide guidelines and/or policies as this is a relatively undeveloped sub-industry in the region. The hydrocarbon industry therefore presents a number of economic opportunities. Importantly, emphasis must be placed on responsible management of the industry to protect the environment for future generations.

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Tourism Development in the Blue Economy

Challenges for Indian Ocean Rim Countries

Larry Dwyer

Introduction

Tourism is important to many coastal and marine regions in the Indian Ocean Rim (IOR) region, as it offers significant potential for growth and employment in related industry sectors. The IOR region is one of the world's great melting pots – a confluence point for African, European, Arab, Indian, Chinese and Indo-Malay people and cultures. Coastal and marine tourism present opportunities to raise local incomes, strengthen and enhance local infrastructure, and contribute to the wellbeing of local communities. However, tourism in the Blue Economy also has social and environmental effects that transform coastal environments, sometimes in undesirable ways. The key challenge is how to develop the Indian Ocean's tourism potential without adding significantly to already existing pressures. Essentially, tourism development must accord with the principles of sustainability. This requires a detailed account of its current and future economic, social and environmental impacts, and address the needs of visitors, the industry, the environment and host communities.¹

Specific aims of the chapter are: first, to provide an overview of coastal and marine tourism in the Indian Ocean; second, to identify the impact of coastal and marine tourism on IOR countries; third, to identify challenges to sustainable growth of coastal and marine tourism, and the implications for different stakeholders; and fourth, to explore effective governance structures to better realise the potential benefits of development for all countries. It is concluded that the Blue Economy has substantial potential to generate positive economic impacts in all countries of the IOR, and as a catalyst for regional economic growth, but that several challenges must be addressed for development to proceed in a sustainable way.

An overview of coastal and marine tourism in Indian Ocean Rim Countries

Table 13.1 below presents an overview of all types of tourism in IOR economies. The destinations are ranked according to size of contribution of the travel and tourism industry to gross domestic product (GDP). The Seychelles is the most heavily dependent economy, with 21.2 per cent of its GDP contributed by travel and tourism. The second and third ranked economies are Mauritius (11.3 per cent) and Thailand (9.0 per cent). Other economies with a relatively high contribution from travel and tourism are Malaysia (7.2 per cent), Madagascar (5.9 per cent) and Singapore (5.3 per cent). Kenya, Tanzania and the United Arab Emirates (UAR) fall into the 4 per cent range, with ten other countries registering less than 4.0 per cent contribution.

International tourist arrivals worldwide are expected to increase by 3.3 per cent on average a year from 2010 to 2030, to reach 1.4 billion by 2020 and 1.8 billion by 2030. This implies an annual average increase of around 43 million international tourists. International arrivals in emerging economy destinations are expected to keep growing at double the pace (4.4 per cent a year) of advanced economy destination (2.2 per cent a year). In absolute terms, emerging economies will add, on average, 30 million arrivals a year, compared to 14 million by advanced economies. Between 2010 and 2030, projected growth rates in inbound tourism are 5.8 per cent (East Africa), 5.1 per cent (S.E. Asia), and 6.0 per cent (South Asia) - each of which exceeds the global average growth rate of tourism. Fuelled primarily by economic growth and lower transport costs, tourism numbers to East and Southern Africa are projected to rise from 12 and 13 million, respectively, in 2010, to 37 million and 29 million by 2030, while tourism to South Asia is projected to increase from 11 million to 36 million.² Regional initiatives are also important for future tourism numbers, as destinations in the IOR develop tourism strategies that incorporate new product development, industry networking and marketing efforts.³

Many destinations in the IOR region have experienced volatile tourism numbers due to adverse economic conditions and political instability (e.g. Madagascar, Kenya, Comoros and Tanzania), while others (Seychelles and Mozambique) have experienced a healthy upward trend in tourist numbers over the past five years. The projected growth of the travel and tourism contribution to GDP between 2013 and 2022⁴ ranges from above 6 per cent (Thailand, Tanzania, Sri Lanka, Mozambique, Bangladesh and India), to below 4 per cent, and hence below the global average (Singapore, UAE, Australia, South Africa, Yemen).

Table 13.1: *Tourism in Indian Ocean Rim Countries*

Country	International Arrivals 000'	International Tourism Receipts (\$million)	T&T Industry GDP (US\$ millions)	T&T Industry GDP %	T&T Industry Employment (1,000 jobs)	T&T Industry Employment %	Projected growth rate T&T GDP 2013-2022 (%)
Seychelles	230	343.6	240.6	21.2	9.7	22.7	4.3
Mauritius	993	1 321.0	1 326.1	11.3	61.8	10.8	4.4
Thailand	26 547	42 080.2	34 928.0	9.0	2 562.9	6.6	6.7
Malaysia	25 715	21 496.3	22 389.6	7.2	880.8	6.7	4.4
Madagascar	196	321.0	599.2	5.9	224.9	4.6	5.1
Singapore	11 898	19 056.9	15 307.4	5.3	147.2	4.3	3.4
Kenya	1 433	880.6	2 119.8	4.8	226.3	2.3	5.2
Tanzania	1 063	1 880.4	1 506.4	4.5	402.3	3.8	6.2
UAE	9 990	11 564.3	15 378.7	4.0	291.3	5.3	3.1
Sri Lanka	1 275	1 715.0	2 659.1	3.9	286.2	3.5	6.1
Mozambique	1 886	241.0	461.2	3.2	273.0	2.4	6.1
Indonesia	8 802	9 119.2	27 059.7	3.1	3 042.5	2.7	5.3
South Africa	9 537	9 237.5	10 680.8	3.0	645.5	4.6	3.9
Oman	1 551	1 222.4	2 556.0	3.0	36.8	3.3	5.4
Yemen	990	940.0	1 344.1	2.9	152.1	2.5	2.4
Australia	6 382	31 253.8	39 043.3	2.6	522.3	4.5	3.4
Iran	4 769	1 294.0	8 239.4	2.2	414.7	1.9	5.7
Bangladesh	148	128	2 845.8	2.1	1 328.5	1.8	6.1
India	6 968	18 397.1	37 184.9	2.0	22 320.2	4.9	6.4
Somalia	n/a						
Comoros	n/a						

Source: Compiled by author from WEF, 2016. Some data not available (n/a)

By world standards, the total number of international visitors per year is small for most IOR countries, and intra-regional travel remains limited. The relatively small numbers of international tourists reflect the fact that the IOR is not very well known within the global tourism marketplace.

Table 13.1 does not enable estimation of the type or contribution of coastal and marine tourism in the countries listed. While in the Seychelles, Mauritius and Comoros, the tourism sector is almost entirely made up of leisure-based coastal tourism, other countries (such as South Africa, Madagascar, Tanzania and Kenya) have more diversified tourism products. South Africa serves as an important air and cruise hub for the region, receiving many international tourists interested in combining safari trips with beach destinations. Relatively mature coastal areas with developed tourism industries in the region include the Seychelles, Mauritius, Thailand and Sri Lanka.⁵ These destinations increasingly cater for 'mass tourism' and are also associated with an expanding second home market. Currently under-developed areas that are likely to see more tourism development in the near to medium-term future include Madagascar, the UAE and Yemen.

The Indian Ocean features many small island developing states (SIDS) and archipelagos, such as Mauritius, the Seychelles and Comoros. These face common social, economic and environmental challenges resulting from characteristics such as a small population, a narrow resource base, remoteness, high dependency on development assistance and international trade, poor infrastructure, lack of skilled/managerial/technical personnel in tourism and hospitality, and vulnerability to natural disasters and the effects of climate change⁶

Trends Supporting Continued Growth in Coastal and Marine Tourism

Future coastal and marine tourism in the IOR region is affected by the same economic, demographic, technological, social, environmental and political factors that influence worldwide tourism flows in general.⁷

Demand side determinants are both general and specific. General determinants include: economic growth; increasing populations; increased longevity of humans; increasing urbanisation; higher standards of health care; changing work patterns, with more flexibility in terms of travel plans; a wider spread of education; migration; stress management through holiday escapes; and changes in people's values, needs and aspirations. As more material needs are satisfied, tourists seek newer, richer, deeper and more authentic experiences.⁸ This generates greater interest in combining coastal opportunities with other experiences (through excursions or multi-centred holidays), as well as growth in the popularity (and expectation) of all-inclusive offers and facilities, growth in cruise tourism, and growth in coastal second homes.⁹

Supply side determinants include: developments in information, communication and transportation technology; continuing growth in the size of travel companies and intermediaries; the continuing influence of destination management organisations (DMOs); deregulation and liberalisation of air transport, and ‘open skies’ policies.

Tourism is now a serious development strategy for the less developed world, with the support of institutions such as the World Bank and International Monetary Fund. The globalisation of social networks, whether through multinational companies, higher education, or international civil society, can be expected to drive further growth of tourism and travel.¹⁰

Impact of coastal and marine tourism

Coastal and marine tourism globally is associated with mass tourism involving standardised and all-inclusive package tour holidays.¹¹ The projected increase in numbers of tourists worldwide implies that increasing numbers of people will access more and more of the marine world, with its sensitive and fragile environments. Numerous studies have identified the possible benefits and costs of coastal tourism for the economy, society and the environment.¹² A selection of possible economic, environmental and socio-cultural effects appears in Table 13.2.

Table 13.2: *Possible Economic, Environmental and Socio-Cultural Effects of Coastal and Marine Tourism*

Economic Effects	
Economic Impact: Positive	Economic Impact: Negative
■ Stimulates local production, thus contributing to household incomes and standard of living. ■ Generates investment in new businesses, growth of local businesses and business profits. ■ Increases employment opportunities. ■ Can be a good employer of women and disadvantaged groups. ■ Enables capacity building through tourism-related professional training, and development of business and organizational skills.	■ Can create a shortage of goods and services in peak season, resulting in increased prices. ■ The competition for space with other coastal economic activities can increase land prices beyond local affordability. ■ Additional demands are made on public services and facilities. ■ Increased tourism can also increase the economic vulnerability of an area, with too much economic dependency on one industry. ■ Other industries may decline as resources flow into the tourism industry.

■ Generates foreign exchange earnings for the national economy. ■ Increases local development and infrastructure provision, including public transport networks. ■ Is a form of economic diversification that increases government's tax base. ■ Expands an economy's export base. ■ Assists in the development of remote areas. ■ Diversifies the local economy, offering additional livelihood opportunities for communities. ■ Helps to develop local supply chains, thus generating further employment and income in other economic sectors. ■ Tourism expansion may be associated with higher levels of public indebtedness and/or higher taxes to pay for increased infrastructure and services. ■ Tourism funding can lead to reduced public expenditure on essential community services. ■ Local employment can be low paid, unskilled, part time, and seasonal, with limited opportunity for advancement. ■ Leakage of tourist expenditure to externally based tour operators and investors reduces the full economic benefit of tourism to locals. ■ Little long-term commitment to community livelihoods. ■ Seasonality adversely affects business profitability and stability of employment.	
Environmental Effects	
Environmental Impact: Positive	Environmental Impact: Negative
■ Coastal and marine tourism can be a relatively 'clean' industry. ■ Can help to support the preservation and revitalisation of natural and social heritage. ■ Revenue from marine park entrance fees, user permits and tourist taxes can help to protect and manage environmentally sensitive coastal and marine areas. ■ The dependency of tourism on attractive coastal environments and cultural heritage can increase stakeholder awareness of the importance of conservation and concern for environmental quality.	■ Development of infrastructure to support coastal and marine development can have an adverse environmental and social impact. ■ Adverse environmental effects of coastal and marine tourism include: pressure on marine ecosystems; physical destruction of marine areas and loss of amenity; loss of marine life habitat and biodiversity; erosion of beaches and coastline; introduction of non-native species, toxins and wastes; pollution of ocean, sea, land and air; resource consumption and competition; changes in the natural dynamics of coastal ecosystems. ■ Strain on local supplies of fresh water. ■ Substantial carbon footprint with a contribution to global warming. ■ Climate change will particularly affect coastal and marine areas globally.

Socio-cultural Effects	
Socio-Cultural Impact: Positive	Socio-Cultural Impact: Negative
■ Promotes mutual understanding between visitors and residents. ■ Encourages pride in local cultural traditions and identity. ■ Increases availability of recreation facilities and leisure opportunities for locals. ■ Increased job opportunities in more remote areas can help reduce migration to urban areas. ■ Economic support for the preservation of local culture through the sale of handicrafts produced by local communities.	■ Fosters an increasingly hectic community lifestyle. ■ Seasonality is associated with an immigrant workforce and attendant social problems. ■ Conflict between tourists and residents for available services, facilities, and recreational and employment opportunities. ■ Visitor behaviour may be perceived to be 'intrusive' by locals. ■ 'Staged authenticity' reduces or destroys the cultural value of traditional cultural events, arts and crafts, for both host and guest. ■ Degradation of cultural sites can occur when historic sites and buildings are demolished to make way for tourist facilities.

Source: constructed by author

As Table 13.2 indicates, coastal and marine tourism development in the IOR is associated with both positive and negative impacts in each of the three pillars of sustainability (economic, environmental and socio-cultural). If tourism is to develop in a sustainable way, stakeholders should attempt to maximise the potential positive features while minimising the negatives. This will often require trade-offs to be made in planning, development and policy contexts.

Challenges to the sustainable growth of coastal and marine tourism

Sustainable development is that which enhances the positive economic, socio-cultural and environmental effects of tourism, while minimising the negative effects.¹³ Historically, coastal and marine tourism development has faced a variety of barriers to sustainable operations. If we are to develop a genuinely sustainable approach to its development in the IOR region, several major challenges must be addressed, as discussed in the next section.

1. Rapid and uncontrolled urbanisation

Coastal tourism development patterns in many IOR countries are typically driven by broad market forces in a relatively unplanned and unregulated environment. The direction of development, including types of supporting infrastructure, is often controlled by political elites who exert an important influence in governance processes concerning land allocation.¹⁴ Coastal and marine tourism in the IOR has been characterised by resource exploitation, poorly controlled development and inadequate concern for community livelihoods and wellbeing. Urban development in East Africa in particular has had a number of negative effects, including coastal degradation and beach and soil erosion, untreated sewage entering seas, the destruction of important coastal habitats, land saturation and a decrease in the land available for agricultural and other uses.¹⁵ Along many coastlines of the IOR (e.g. Kenya, Zanzibar and Mozambique), tourism has developed in a haphazard fashion, causing major social and environmental problems.¹⁶

2. Lack of regional co-operation

Tourism in the IOR is characterised by a lack of regional co-operation in matters such as product development, multi-country packaging, intra-regional travel, promotion, as well as cross-cutting issues such as training, quality assurance, and environmental standards. Typically, limited resources (both financial and political) are committed to policy, partnerships and sector promotion, despite the economic rationale for greater regional co-operation.¹⁷

Despite the challenges, momentum is gathering for greater tourism co-operation among some Indian Ocean countries. The 2013 launch of the Vanilla Islands Organization (VIO), comprising Comoros, Madagascar, Mauritius, Réunion and the Seychelles, is a positive step towards greater regional tourism collaboration in respect of marketing and public relations, product development, standards creation, trade fair representation and knowledge sharing.¹⁸ Collaboration in collecting statistics - presently an uneven and inconsistent process - is expected to provide useful data to guide marketing efforts. The Indian Ocean Commission and the Indian Ocean Rim Association (IORA) have also emphasised that regional tourism integration is a priority for the region. Opportunities for greater regional tourism integration are beginning to emerge in the areas of improving regional air connectivity, co-operation in capacity building and workforce development, collaboration in product packaging, and joint marketing.¹⁹ Pooling IOR countries' resources to conduct joint partnership and marketing activities would likely allow their limited resources to raise the region's profile.

However, economic and social differences between IOR countries, while providing a possible richness in tourism offerings, also add complexity to tourism sector integration. Differences in stages of industry development (which is reflected in the scale of tourism in each country) and in institutional capacity to manage the sector, can impact the development of any meaningful and effective collaboration across the region.

3. Dependence on Tourism

The demand for tourism is extremely sensitive to crises of every type (economic, environmental and political). Destinations that over-specialise in tourism are particularly vulnerable to crises and can incur substantial losses when conditions change.

Coastal and marine tourism destinations, particularly in small island states, such as are located in the IOR, are typically susceptible to two types of dependence. One type of dependency is linked to tourism as an export market. Tourism flows are very sensitive to economic, political and natural phenomena.²⁰ A second type of dependence occurs within the tourism market itself. Destinations can become too reliant on tourism inflows from origin markets, or on a specific tourism product, for instance beach recreation, yachting, whale-watching, or diving.

Dependence on tourism in the IOR is evidenced by the seasonal nature of tourist arrivals, which is tied to holiday periods and weather conditions in origin markets. In peak periods, destinations may lack the capacity to supply adequate amounts of the required energy, food, land, water and other resources that may be in short supply. An example may be Cape Town in South Africa, where a severe drought has led to water restrictions that affect tourists as well.

In general, more attention should be given to determining how SIDS and archipelagos can participate in new forms of marine tourism while avoiding the types of dependency that characterise existing forms of tourism.²¹

4. Impact of other industries on tourism

In the IOR, as elsewhere, tourism has links with a substantial number of other industries. The operations of non-tourism industries in the IOR have the potential to create habitat loss, biodiversity loss, and effects on ecosystems that adversely affect coastal and marine tourism. Activities related to aquaculture, minerals exploration and extraction, spills from oil tankers, garbage from merchant shipping, and so on, can degrade the suitability of coastal and marine locations for tourism purposes. Coral reefs are particularly vulnerable to sea mining activity. Emerging ocean industries must also be studied for their potential impact on tourism.²²

As other marine-related industries expand, there will be a need for greater awareness of the associated impacts, including the development of monitoring and mitigation strategies, in order to minimise or circumvent them.²³ Given the increasing competition for use of marine space, efficient management is needed, both to minimise potential conflict and to nurture synergies between different marine uses. Opportunities to develop protocols with other industries (cargo shipping, oil and gas) exist, and marine governance processes are needed to monitor the inter-industry effects associated with the expansion of each of the emerging ocean industries.

5. Impact of tourism on other industries

The tourism industry is itself a type of mega-industry, comprising characteristic yet connected industries, such as accommodation, transport, food and beverage services, travel agents, tour operations, conventions, entertainment facilities, retail trade and so on. In this respect, tourism has the potential to be an important catalyst for economic growth in the IOR.²⁴ It needs to be noted, however, that an expanding tourism industry draws resources (land, labour, capital) from other industries. For destinations that have little excess capacity, the key effect of an economy-wide expansion in inbound tourism expenditure is to alter the industrial composition of the host economy, rather than to generate a substantial increase in aggregate economic activity.²⁵ In addition, conflict over resources exists between tourism and the mining, agriculture and real estate industries.²⁶

Thus, tourism planning should not be undertaken in the absence of estimates of the effects on industry balance in the destination. Infrastructure that supports tourism development can also support the development of various other industries. The cruise sector, for example, has important synergies with other industrial sectors such as accommodation, land transportation, and port facilities; as does merchant shipping. Conversely, seaside tourist developments can have an adverse effect on existing local tourist accommodation and restaurants, and on the social and cultural fabric of local communities.

Problematically, the tourism sector is also an additional source of pollution along the coastlines of all countries.²⁷ There is unfortunately very little data on pollution levels attributable to the tourism sector in IOR countries. This flags a need for scientific research and mapping, and an increased need for marine monitoring, surveillance and control, including techniques for a zero-harm discharge policy.²⁸ Visitor and operator certification schemes and codes of conduct can play an important role in reducing the adverse impact of tourism activities. If effective strategies for enhancing the environmental benefits of tourism in the IOR is to be supported, while simultaneously adding value to product offerings and fostering

innovation, strong collaborative relationships between all tourism stakeholders are essential.

Most IOR countries do not adequately regulate the performance of tourism enterprises in managing the impact on the coastal and marine environment. Monitoring systems to enforce good environmental behaviour are also not in place.²⁹

6. Capacity building, education and training

Due to seasonality and the lack of career opportunities, the coastal and marine tourism sector often has difficulty in attracting or maintaining enough skilled personnel to work in its various sectors.³⁰ This can lead to problems in service quality and erode destination competitiveness. Few tourism businesses in IOR destinations offer formal in-house training programmes. Service levels in many establishments in the region are low, and often not commensurate with prices charged. In most IOR countries, the current accommodation classification system does not involve regular reviews of properties, thus eliminating an important incentive for maintaining standards.³¹

There are however several reputable institutions in the IOR that can provide valuable capacity building opportunities. In order to address the capacity needs of tourism training institutes (TTI), a number of bilateral partnerships have been forged between TTIs across the region. Partnerships often involve exchanges of instructors for continued learning, facilitation of internship placements for students, and technical assistance in areas such as curriculum development, training material creation, and programme administration.³²

To achieve sustainable development of coastal and marine environments, as well as mitigation and adaptation strategies to address climate change, capacity development for ecosystem-based integrated coastal and ocean management is essential. It would also help to preserve biodiversity and resources and provide for sustainable community livelihoods.³³ Despite its importance, however, the reality is that financial considerations will determine the extent of capacity building that occurs.

7. Transport

Without adequate transport connections, between and within countries and regions, operators and host communities cannot take full advantage of the potential of tourism expansion to support the development of local economies.

Aviation is critical to the expansion of many coastal and marine destinations in the IOR.³⁴ Many of the more remote island destinations in the IOR have very poor transport links with mainland areas. Currently, flights to and from small islands

are generally limited and very costly.³⁵ The high cost of regional flights acts as a deterrent for those interested in visiting multiple IOR countries. The high flight costs can be attributed to: failure to implement air liberalisation policies; some inefficiently run national carriers; high taxes; expensive handling service fees; and airline pricing structures that fail to encourage multi-country travel within the region. Financial troubles have significantly limited the ability of national carriers to serve traditional source markets or expand to strategic emerging markets. A major challenge is to improve intra-regional air transport, as direct connectivity is fundamental to regional integration.

An option that deserves greater attention, especially for small airlines with important long-haul markets, is the creation of strategic partnerships with larger airlines. In the longer term, the entrance of a low-cost carrier could significantly improve regional air connectivity to more remote destinations, which would benefit the region's residents and tourists.³⁶

While the Indian Ocean has a high potential for cruise tourism, the market remains limited and has been affected in past years by piracy. Another problem is limited port infrastructure, which restricts the number and size of vessels that can be received. Other gaps include: the lack of a clear cruise homeport in the region; poor roads leading from ports to key tourism attractions; limited opportunities for local businesses to offer services to cruise passengers; inadequate visa and immigration processing services in port areas; and a lack of environmental regulations for cruise ships.³⁷ Due to the multi-destination nature of cruise itineraries, gaps in any of the cruise destinations hinder the entire region's ability to attract more cruise ships.

A more coordinated approach will be necessary if IORA Member States are to attract more cruise tourists in a sustainable manner. The Cruise Indian Ocean Association (CIOA) promotes cruise tourism throughout the broader region. The association is composed of port authorities in the sub-region, and the national tourism organisations of Kenya, South Africa and Tanzania. Over time, membership of CIOA should be extended to other destinations. Ideally, strategy should address the issue of the integration of local businesses into the cruise tourism value chain, so that they can enjoy a significant proportion of the benefits from cruise tourism while addressing potential environmental impacts. Cruise tourism is potentially a key platform for regional integration efforts and economic growth.

8. Climate change

Climate has a major influence on destination choice. Climate change will impact on global economic growth, which will in turn impact upon global tourism numbers,

given the importance of income as a determinant of tourism growth. This will affect tourism numbers and expenditure in many countries of the IOR.

Rising sea levels associated with ocean warming are causing coastal erosion and loss of beach areas. This problem increases the cost of protecting and maintaining water-adjacent recreational areas and waterfront tourism precincts. Small island tourism destinations, such as the Seychelles, are particularly vulnerable to sea level rise and the erosion of beaches and shorelines. A rise in sea surface temperature will cause coral bleaching and marine resource degradation and species extinction, which will reduce the attractiveness of destinations. Tropical islands will be susceptible to intense climatic events such as hurricanes, and these may become more frequent. Changes in weather patterns will severely damage or destroy tourism attractions, resulting in reduced visitation and reduced economic advantages.³⁸

In addition to whatever mitigation measures are available, destinations in the IOR should attempt to ensure that adaptation actions are integrated into development policy and planning at every level. A good strategy is to attempt to better integrate climate change responses into a broader risk management policy for the tourism sector. Building adaptive capacity involves creating the information and conditions (regulatory, institutional and managerial) needed to reduce a destination's vulnerability to climate change.³⁹

9. Low levels of innovation

Changing consumer values have increased the demand for tourism products and services that provide a unique and customised experience. Across the IOR, opportunities exist for expanded offerings through multi-destination packaging of tourism products, such as hotels, tours and attractions, as well as the development of new kinds of coastal and marine products. Yet, throughout the region, potentially interesting sites or items are either not presented, not promoted attractively, or not well linked with other coastal and marine tourism offerings.⁴⁰ Moreover, in many coastal and marine areas in IOR economies, operator performance is quite weak.⁴¹ This not only affects profitability but can be very disruptive for societies by causing negative impacts on job quality and security.

It is important to provide strong incentives and specific mechanisms for business owners to continually improve service quality.⁴² A lack of innovation culture constrains entrepreneurship and creative product development. Operators in the IOR should explore opportunities for cost reduction associated with higher quality service, as well as product, service and marketing innovation as the source of competitive advantage to expand profitability and market share.

10. Lack of information and data

The information needed for public policy formulation and for private sector decision-making, is often clouded by substantial uncertainty. Data is often incomplete, outdated or inconsistent, which makes country comparisons in tourism, for instance, very challenging. Many parts of the Indian Ocean, particularly in the deep sea, are virtually unmapped. Moreover, the information required is not confined to scientific data. The human component is generally under-documented, and the social sciences and their role in the sustainable development of coastal and marine tourism is often ignored.

In order to improve planning and destination management, gaps in data need to be identified. In particular, tourism statistics are critical if policy makers and businesses are to properly understand tourism sector performance and emerging trends. Access to information about tourist perceptions, values and needs enables a destination to formulate appropriate marketing and product development strategies to adapt to changing market conditions.⁴³

The limited availability of sector-specific information restricts networking opportunities in coastal and marine tourism, particularly for smaller companies.⁴⁴ Gaps in key data adversely affect investment and increase the risk of project failure. We need to better systematise knowledge to assist with better policy formulation, including the integration of government, NGO and private sector data. Initiatives, such as OURCOAST and Marine Knowledge 2020,⁴⁵ which share data through a collaborative approach, are applicable to established and emerging coastal and marine industries, and can be extended to IOR destinations. All IORA countries would benefit from sharing statistics that have been collected following a similar methodology and using the same indicators. This practice has been in place for many years among members of the Caribbean Tourism Organisation and South Pacific Tourism Organisation and has proven beneficial. Technical support may also be solicited from the WTO, which is active globally in establishing best practice for tourism statistical systems.⁴⁶

11. Financial and resource constraints

Constraints on investment funding impedes the potential growth of coastal and marine tourism in the IOR.⁴⁷ Investment in general infrastructure, the revitalisation of waterfronts and seasonal festivals, and the concentration of water-based activities can generate increased visitor numbers, as well as enhance the quality of life of community members.

Many destinations and operators in the IORA have limited access to credit to fund capacity- increasing investment and innovation. Banks often lack the knowledge

required to assess business plans and do risk assessments. Furthermore, dispersed economic actors in the coastal and marine sector, that are predominately small and medium enterprises, can face additional problems in securing finance from venture capital sources. Greater attention must be paid to the potential for Public-Private Partnerships (PPP) to support coastal and marine tourism.⁴⁸ International agencies that support funding and technical assistance programmes should continue to help IORA Member States in the planning and management of coastal and marine tourism. Greater funding would enable the sharing of experience and knowledge between countries. Furthermore, SIDS governments will need substantial international financing for climate adaptation and mitigation strategies.⁴⁹

Sending a strong signal of government support for (sustainable) coastal and marine tourism can reduce the risk for investors and provide a catalyst for financial investment. Eliminating burdensome or uncoordinated administrative procedures that impede access to financial support for innovative projects is also important, keeping in mind that what is needed is not more investment *per se*, but investment in the *right* types of projects to enhance destination competitiveness.⁵⁰

12. Leakage and offshoring

A key requirement for sustainable coastal and marine tourism development is for local communities to benefit through poverty alleviation, improved livelihoods and job creation. Ideally, a growing tourism industry should also encourage better management and conservation practices by local communities. However, leakage of tourist expenditure occurs through the high import content of tourist consumption bundles, as a result of a narrow production base in many coastal and marine destinations.⁵¹ Coastal regions often fail to fully capture the economic benefits generated by cruise tourism, which limits the economic growth potential offered by this market.

The traditional leakage of expenditure issue has evolved to encompass offshoring, the collective term for the movement, relocation and concealment of resources associated with global capitalism. It is important to understand the political economy in which commercial tourism interests operate, as this can impact substantially on net benefits to destinations. Benefits to local communities could be enhanced through strengthening supply and demand conditions for increasing employment, strengthening local supply chains, and fostering community-based initiatives that are consistent with sustainable development.⁵² Community tourism is a means of reducing leakage, but it has had little market penetration in most IOR economies. Various mechanisms for improving community livelihoods through tourism have been identified, and each is relevant to coastal and marine destinations in the IOR.⁵³

13. Poor governance

There is failure of good governance of coastal and marine tourism nationally, regionally and internationally. A traditional terrestrial focus of policy making has retarded the development of governance processes for coastal and marine tourism. Many developments occur within relatively loosely structured or ineffective regulatory regimes that reflect informal relationships where those who stand to gain directly (as landowners, speculators or investors) form local growth coalitions that pursue private economic interests within the broader macro-political environment.⁵⁴

Effective governance arrangements should be developed in IORA to protect coastal communities from political short-termism. This can be achieved by harnessing reliable information on which to base tourism development decisions. If governance processes are to be effective in meeting the above-mentioned challenges, tourism must serve as a positive force in coastal and marine areas. Effective governance processes require a coherent policy framework to ensure that appropriate policies are implemented. Explicit objectives would include the conservation of coastal and marine environments, maintenance of biodiversity and contribution to the wellbeing of residents.⁵⁵ The next section deals with the importance of good governance in meeting all the challenges highlighted above.

Meeting the challenges through good governance

Issues of governance are complex and space limitations preclude a comprehensive discussion of the approaches that could be adopted in the context of the development of coastal and marine tourism in IORA. Many of the opportunities associated with future development of coastal and marine tourism occur within the broad context of ecosystem-based management.⁵⁶ This section focuses on four governance processes that could help to meet the challenges identified.

1. Integrated planning

Policies that are relevant and coherent across governments in different jurisdictions and at different levels (local, regional, national) are needed for governing coastal and marine tourism.⁵⁷ Specifically, there is a need for the implementation of an integrated coastal zone management (ICZM) process among IORA countries; one that considers the various pressures on, and opportunities for development, for a range of different industries competing for land and resources. Each of the IOR countries face a different set of issues in realising their full tourism potential within

the context of the Blue Economy, and it is only by resolving these issues that any regional tourism potential can be fully tapped.⁵⁸

Tourism management plans play a useful role in identifying the relative importance and positioning of coastal tourism within national tourism strategies.⁵⁹ Many IOR countries lack tourism policies, strategies and plans at a sub-national level. Reflecting international best practice, greater attention should be placed on preparing such plans through stakeholder participation at a local level in identified destinations across the region and the rim. Any prominence afforded to tourism in over-arching development policies can help to influence all IOR governments to take the sector more seriously. Tourism management plans should be created or reviewed through a highly consultative process to cover issues such as: appropriate tourism governance structures that provide for private sector and civil society engagement; intra-governmental structures that link environmental and tourism agencies; area structures that involve local authorities, tourism, conservation and community stakeholders. All such plans should be developed in the context of comprehensive ICZM land use planning.⁶⁰

2. Multi-stakeholder engagement

Governance structures for sustainable coastal and marine tourism must effectively engage with different stakeholders at different levels, while ensuring sufficient capacity to deliver outcomes that meet their different objectives.⁶¹ In the IOR, this approach would attempt to build the resilience of existing coastal destinations by building relationships that promote innovation and destination capacity building. The role of key players in delivering sustainable coastal and marine tourism development in the IOR should be clarified and responsibilities at different levels of governance should be identified.

There is a particular need for coordinated engagement of both the public and private sectors. To date, public-private partnerships have not figured very often in coastal and marine tourism development, but may be beneficial in fostering stakeholder collaboration, as well as in securing additional financial support. In IOR countries, organisations representing environmental and social interests and initiatives potentially have a very important role to play in facilitation and capacity building.⁶² Academic and research bodies, training institutions and local consultants can also provide highly valuable knowledge and services.⁶³ International agencies should continue to provide financial and technical support to IOR nations to support in the planning and management of coastal and marine tourism, as well as in the enabling of knowledge sharing among the various countries.

Bringing stakeholders together in a tourism development context is quite feasible, but maintaining commitment over time is a greater challenge. Opportunities

exist for setting up social dialogue committees for different coastal and marine tourism sub-sectors.⁶⁴ Destinations could create permanent, structured forums for discussion, which bring regional and local actors (such as cruise operators and ports and coastal tourism stakeholders) together. Such structured communication platforms would allow the industry to liaise closely with all relevant stakeholders to exchange ideas, develop themes, encourage best practice and, hopefully, build a shared vision to address current challenges. This initiative could help to ensure that tourism is better mainstreamed in all governmental policy making and considered more closely in governmental decision-making processes.⁶⁵

Establishing an ocean knowledge and solutions platform for IORA would be an important step in advancing a regional platform, and this could assist in the dissemination of knowledge and the transfer of skills and capacity across all destinations, including technology transfer.

3. Community engagement and benefits

Coastal and marine tourism destinations in IORA have opportunities to strengthen local employment and supply chains. Tourism and hospitality training play an important role in capacity building, and in helping to form multi-stakeholder coalitions to ensure sustainable development to benefit host communities.⁶⁶

The development of coastal and marine tourism should explicitly espouse the objective of creating and maintaining sustainable livelihoods. This objective includes a concern for local prosperity, social equity and community wellbeing.⁶⁷ Policies should: recognise the importance of preserving and maintaining clean and attractive coastal environments; include the maintenance of existing levels of biodiversity through conservation efforts, together with community inclusion in local decision-making. Various mechanisms for poverty alleviation through tourism have been identified by UNEP (2010) and UNWTO (2013), and these should inform policy actions across the region.

While ecotourism has the potential to create economic incentives to support sustainable conservation policy and practice, at the present time, ecotourism services are relatively undeveloped in coastal regions when compared to land-based markets in the IOR.⁶⁸ Nevertheless, guides to good practice ecotourism are available to tourism industry stakeholders.⁶⁹ Outside the ecotourism sector, tourism can support protected areas through admission fees and charges used directly as a source of revenue for conservation and management. Income from nature-based tourism can also support local communities, providing an incentive for conservation activity in the area.

Coastal and marine tourism development in IORA and the region as a whole should be sensitive to the needs and aspirations of the host community. Effective

governance arrangements should protect coastal communities from political short-termism and should be able to harness reliable information and data on which to base decisions. Communities that offer tourism will require assistance in improving their standards, perhaps through the creation of strong umbrella associations. Community members must be encouraged to consider the future and imagine what they would like their community to be. ('What type of tourism do we want, if any?'). This involves identifying what is really valued or desired by the host community, and the role that tourism might play in community life.⁷⁰

4. Deployment of management and evaluation tools

Coastal and marine tourism that is likely to have a significant environmental impact should be subject to Environmental Impact Assessment (EIA) processes. An EIA is a potentially powerful instrument in ensuring that tourism development is sustainable and that it does not have an unacceptable impact on existing industries, social values or natural environments.⁷¹ Unfortunately, there is disparity between IORA countries as to the types of developments that require an EIA. An important advantage of EIA is the role that is accorded to community consultation and engagement.⁷²

Placing a value on ecosystem services in monetary terms is central to communicating the importance of ecosystems and biodiversity to policy makers. Economic analysis and instruments are part of the toolbox required to improve measurement and valuation of ecosystem services.⁷³ They are especially useful in cases of competing claims for ocean space, and the search for an appropriate balance between the use of marine space and the protection of the ocean and coastal environment. Thus, for better informed integrated ocean management, IOR countries should attempt to make greater use of economic analysis and economic instruments. The establishment of international and regional platforms for the exchange of knowledge, experience and best practice would foster more informed economic and financial evaluation of both ocean use and non-use values. This would underpin efforts to evaluate the economic effectiveness of public investment related to coastal and marine tourism.

Conclusions

The blue economy has substantial potential for generating a positive economic impact throughout the countries of the IOR, and as a catalyst for regional economic growth. Tourism, as an important aspect of the Blue Economy, is one of the best tools available for conserving the region's unique natural and cultural resources.

However, there are many challenges to the sustainable growth of coastal and marine tourism. In this chapter it is argued that these challenges can only be overcome if good governance processes are put in place. In all IORA Member States, there is potential for public sector organisations and agencies to work directly with private sector enterprises to encourage good practice in the management and sustainability of tourism operations. Private sector leadership and commitment is essential in fostering tourism organisations that generate community benefits and conservation incentives.

Sustainable tourism development of coastal and marine tourism depends on the extent of strategic engagement with national management agencies, local communities and the private sector. Developing management systems and institutions that create incentives for minimising the negative impact of coastal and marine tourism development, while effectively sharing benefits between local and central stakeholders, is essential. While there have been some encouraging developments pointing towards increased tourism collaboration and governance processes among the countries of the IOR, significant challenges remain. Until there is a collective mind-set shift regarding the overall gains to be reaped by all rim countries, regional collaboration in coastal and marine tourism will continue to be opportunistic, and will remain small-scale and less effective than it could be.

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Ocean Renewable Energy

Manta D. Nowbuth, Hema Rughoonundun and Prakash C. Khedun

Introduction

Earth’s climate is changing: it is warming at a dangerous pace. Humans, through the consumption of carbon-emitting fossil fuels are responsible for this change to some extent. Renewable sources of energy could hold the key to reversing the current warming trend. Since the last century, there has been tremendous progress in the development of land-based renewable energy sources, such as solar/photo-voltaic, wind, geothermal, and energy from biomass. Around the world, renewables are becoming established as a mainstream source of energy. Further expanding the renewable energy base inevitably requires looking seaward for more prospects.

The ocean holds enough energy to meet the total worldwide energy demand several times over.¹ Recent investment in research and development, and advances in technologies, has made it possible to harness energy from the ocean in several different forms: wave energy, tidal energy, energy due to salinity difference, thermal energy, marine biofuel, and offshore wind energy. Between these various forms, the ocean holds anywhere between 20 000 to 80 000 terawatt-hours (TWh) of energy (Table 14.1).

Table 14.1: *Global Ocean Energy Potential, from Bard, 2007²*

Energy Type	Annual Generation (TWh)
Wave energy	8 000 – 80 000
Ocean thermal energy	10 000
Osmotic power	2 000
Marine current power	> 800
Tidal energy	> 300

The principal characteristic of these sources of energy is their renewable nature, which makes them an attractive option in the quest for environmentally friendly sources of energy to offset our dependence on fossil fuel. However, the extraction of energy from the ocean is not cheap. Current research is focused on finding ways to harness this energy economically and ensure its commercial viability. Further, the right legislation, regulations and mechanisms to ensure sustainable use while protecting the marine environment have yet to be developed, let alone implemented.

Countries with access to the ocean, especially those that have an extended exclusive economic zone, are well positioned to take advantage of this vast source of energy, in all its different forms. The Indian Ocean, the world's third largest, is home to about a third of the world's population. Twenty-one member states³ are grouped under the Indian Ocean Rim Association (IORA). In 2015, these member states adopted the Blue Economy Declaration, which has renewable ocean energy as one of its priorities. It affirms, *inter alia*, that

... additional incentives in renewable energy are strongly in demand to further decrease the burden on fossil fuels. The time is therefore appropriate to explore the potential of renewable energy derived from the ocean. The ocean offers vast potential for renewable 'blue energy' from wind, wave, tidal, thermal and biomass sources.⁴

In the following sections of this chapter, important renewable ocean technologies currently being developed are discussed, together with their commercial potential and limitations. The potential of these renewable energies for the IORA region, and their current deployment, if any, are presented in the final section.

Wave energy

As wind blows over the surface of the sea, its energy is imparted to the waves. The movement of the waves across the surface of the ocean results in constant vertical movement of water. This energy can be harnessed in the form of kinetic energy, which can be used to power turbines and electric generators and convert the kinetic energy into electricity. The energy output from the movement of the waves is a function of the wave height, speed, length, and the density of the water.

Wave energy as a potential energy source has been recognised by several centuries. In 1799, the first patent for exploiting wave energy was filed in Paris, France. The aim was to use wave movement directly to drive mechanical equipment. In the 1940s, Commander Yoshio Masuda of Japan developed the oscillating water column,⁵ a navigation buoy that was powered by wave energy. The 1973 oil crisis

led to renewed scientific interest in wave energy.⁶ Since then, a number of countries has invested heavily in research, which has led to the development of several wave energy conversion devices and technologies. These can be categorised into: (i) oscillating water columns with air turbines; (ii) oscillating bodies with hydraulic motor, hydraulic turbine, and linear electrical generators, and; (iii) overtopping with low-head hydraulic turbines.⁷

Over 100 pilot plants and demonstration projects have already been developed around the world, but only a few are ready for upscaling and commercialisation. Given that the wave regime is not constant around the world, and every country's coastline is subject to a different wave regime, the right technology should be selected carefully, and its local impact should be adequately assessed before implementation.⁸

Tidal energy

Tidal energy is the conversion of energy from the movement of tides into electricity. Tides are a result of the gravitational pull between water on Earth and celestial bodies such as the Sun and the Moon. As the Earth rotates, the gravitational force acting on the ocean water changes periodically. The attraction produces a bulge in the water, forcing water from the middle of the ocean to move towards the shore. When the celestial bodies are on the other side of the Earth, the attraction is minimal, and water recedes back into the ocean, thus causing tide movements. This process occurs every day, which means that energy from tide movement is an inexhaustible source of energy. Tides have been recognised as a form of energy since as far back as the Middle Ages.⁹

Tidal energy can be harnessed in three different ways: (i) tidal range technologies; (ii) tidal stream (or tidal current) technologies, and; (iii) a hybrid of the two technologies.¹⁰ Tidal range technology is similar to a hydropower plant, whereby a barrage is constructed to hold the water when the tide comes in and when it recedes. Potential energy is converted into mechanical energy through turbines, and ultimately to electrical power via generators. Several plants, with a capacity ranging from 0.4 MW to 254 MW, have already been constructed.¹¹ Tidal stream technology harnesses the kinetic energy of moving water, similar to a wind turbine. Some tidal stream generators also tap into the ocean current to generate electricity.

The main challenges to implementing tidal energy systems are the huge infrastructural costs associated with the construction of barrages, such as dykes and embankments, and the ecological risks that may result from such enclosures.¹²

Ocean thermal energy conversion

Ocean thermal energy conversion (OTEC) is the process of generating electricity using the difference in temperature between cold deep ocean water (usually at depths of 800 to 1 000 m) and warmer shallow or surface water. The sun warms the surface water and produces vapour, which expands and drives a turbine to produce electricity. The cold water condenses the vapour back into liquid, which can be used again in the system.

In the 1970s, the increasing cost of non-renewable fossil fuel drove interest in ocean energy and in investment in the research and development of OTEC technologies.¹³ Since the beginning of this millennium, the process has received significant attention, especially in islands in tropical regions.¹⁴

1. Open and closed OTEC systems

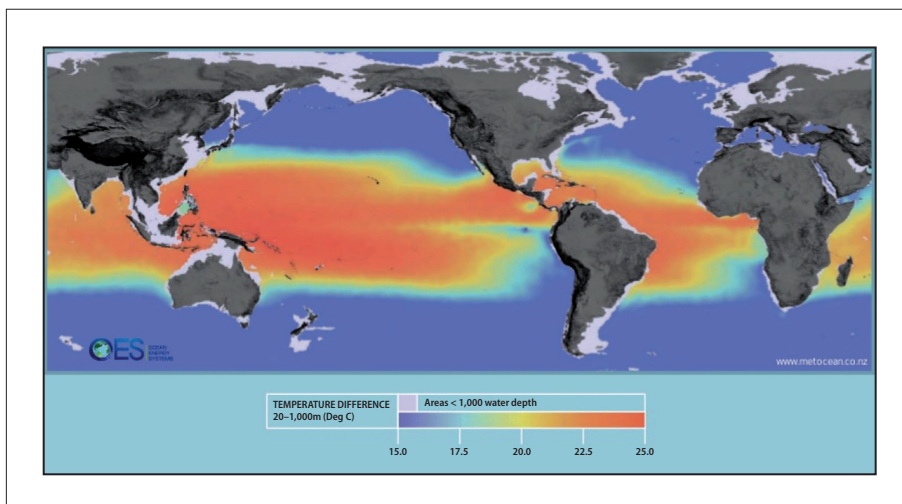
There are two main types of OTEC technologies, based on working fluids: open cycle, which uses seawater; and closed cycle, which uses ammonia. In the open cycle OTEC system, warm water enters a flash evaporator through a valve. The water vapour, which has been stripped of its salt, drives a turbine to produce electricity. The desalinated water is then condensed by the cold seawater, and it can then be used as fresh potable water. The cold water, once it has been used to condense the vapour, can be further used for air conditioning or in aquaculture, as it is rich in nutrients such as nitrogen and phosphates.

The closed cycle OTEC system utilises ammonia as the working fluid, as it has a low boiling temperature, hence providing a higher vapour pressure. Warm water vaporises the ammonia, which drives a generator to produce electricity, and cold water condenses the vapour, which is pumped back into the closed system.

A variation of the closed system is the Kalina cycle OTEC, which utilises a mixture of ammonia and water as the working fluid. Another variation is the hybrid system, which is a combination of both the open and the closed cycles. In the latter case, a flash evaporator generates steam, which in turn drives the closed cycle, and the evaporated water is then condensed into fresh water.

Commercial application and limitations

Of the different forms of ocean energy technologies, OTEC has the greatest potential. An estimated total energy of 30 TW can be made available. Nearly 100 nations and territories, especially those within the sea surface temperature belt of 25° to 30°C, can potentially house OTEC facilities (Figure 14.1).

Figure 14.1: *Estimated Temperature Differences in the Ocean*¹⁵

There are several OTEC power plants already operating around the world with a capacity ranging from 20 kW to 10 MW; several others are in various stages of development. The cost of implementing OTEC varies from \$5 000 to \$15 000 per kW for small plants producing 10–100 MW, whereas large plants that are built on moored ships can cost \$2 650 per kW.

The capital cost is dependent on four factors: the scale of the project; the choice of the type of system; production and use of by-products; and environmental conditions and impact.¹⁶ The environmental impact of such systems can be a determining factor for island nations who rely on tourism. There can be a number of environmental risks when large volumes of nutrient rich water are transferred from the bottom of the ocean to the surface, which disturbs the seabed marine ecosystem and enhances conditions for algal bloom at the surface.

2. Salinity gradient energy

Salinity gradient energy, or osmotic power, is the energy released when two solutions of different salt concentrations are mixed together. It is based on Gibbs free energy. The concept of harnessing salinity gradient energy has been proposed since the 1950s,¹⁷ but received little commercial or industrial interest until recently. Currently, the two methods that are being implemented are Pressure Retarded Osmosis (PRO) and Reverse Electrodialysis (RED). Both methods were developed by Loeb.¹⁸ The two processes are briefly described below.^{19, 20}

Pressure retarded osmosis

In a pressure-retarded osmosis system, two solutions of different salinity, one a solvent (for example, fresh water) and the other a solution (for example, sea water), are brought into contact through a semi-permeable membrane. The membrane allows the water to pass through to the solution side, while retaining the salt. The chemical potential difference between the solvent and the solution drives water from the diluted solution towards the concentrated salt solution. Applying hydrostatic pressure to the concentrated solution ‘retards’ the passage of water, until the pressure reaches the osmotic pressure between the two solutions. Further pressurising the concentrated solution results in reverse osmosis, that is, the movement of water from the concentrated solution towards the fresh water compartment. The pressurised movement of water is used to generate electricity through a turbine.^{21, 22}

Statkraft,²³ a Norwegian renewable energy utility company, opened the first pilot PRO plant in 2009. The pilot plant is able to generate a meagre 2–4 kW - just enough to power a coffee maker. Nevertheless, the company has invested about US\$12 million over a period of 10 years in research and development of the prototype, in the hope that this technology will be widely implemented as a clean carbon-free source of energy.²⁴ The company had planned to upscale the technology into a 2MW power plant, but discontinued investment in the technology owing to limited financial support.²⁵ Others who have invested in the technology include Hydro-Québec, the largest electricity generator in Canada, Japan’s Tokyo Institute of Technology, and utility companies in Singapore and South Korea. NASA is also investigating the use of PRO, not only as a means of power generation, but also for the treatment of wastewater and the production of drinking water aboard spacecraft.

Reverse electrodialysis

In a reverse electrodialysis system, two solutions of different salt concentrations are brought into contact through a set of alternately stacked cation and anion exchange membranes. The compartments between the membranes are alternately filled with a concentrated salt solution and a diluted salt solution. The anion (cation) exchange membranes contain a fixed positive (negative) charge and only allow the selective transport of anions (cations) towards the anode (cathode).

The salinity gradient creates a potential difference over each membrane. Summing the potential difference over the total number of membranes gives the electric potential difference for the system. The chemical potential difference causes ions to be transported through the membrane from the concentrated solution to the diluted solution. In the case of a sodium chloride solution, sodium ions permeate

towards the cathode, while chloride ions permeate towards the anode. Oxidation (reduction) of the anode/cathode surface maintains the electro-neutrality of the solution in the anode-cathode compartment. Electrons released from the anode are transported to the cathode through an external circuit, and this electrical current and potential difference over the system can be used to generate electricity.^{26, 27}

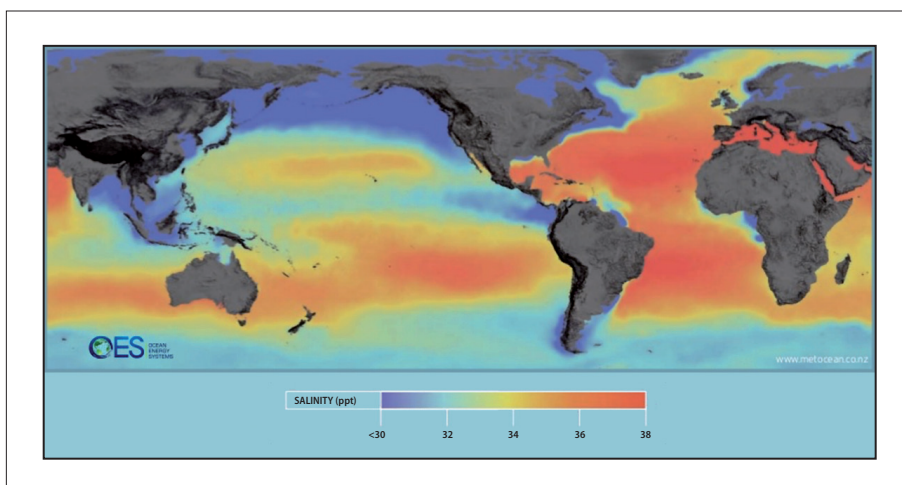
The first application of RED for power generation was initiated in 2003 in the Netherlands, and by 2005 a 5kW pilot plant was developed by REDStack²⁸ and Frisia. REDStack and Fujifilm followed up with a 50kW pilot plant, which began operating in 2013. Further plans include upscaling to a commercially viable stand-alone plant of 200MW by around 2020.²⁹

Commercial application and limitations

Theoretically, the amount of energy³⁰ that can be harnessed from mixing 1m³ of seawater (of concentration of 0.5 mol/L NaCl) with 1m³ of river water (of concentration of 0.01 mol/L NaCl) is 1.7 megajoules (MJ), and that from mixing 1m³ brine (of concentration of 5 mol/L NaCl) with 1m³ of river water is over 16.9MJ. The global salinity gradient energy potential from oceans and seas has been estimated at 3.1TW, but the actual amount that can be harnessed will be less, given the technical and environmental constraints.³¹ If natural and industrial brines are considered, the energy generation potential increases.

Ocean Energy Systems (ocean-energy-systems.org) has prepared a map of the global salinity gradient for the globe (Figure 14.2)). An interactive map is available on their website. Salinity varies across latitudes, with areas having stable temperatures being better suited to harnessing salinity gradient power.

Figure 14.2: *Estimated Salinity Gradient Differences in the Ocean*³²



Apart from the salinity of the ocean, the volume of freshwater discharged is also a determining factor. Based on the spatiotemporal variability of the salinity structure of the ocean, and the available discharge from the major rivers, it was found³³ that rivers such as the Nile and the Niger (with an estimated potential of 2.55 and 0.89 MJ/m³, respectively) are suitable, while the Mekong (estimated potential of 0.06 MJ/m³) would not be suitable. PRO is better suited when saline brine is used, while RED is more appropriate for power generation using seawater and river water.³⁴

Biofuels

The interest in using algae as a source of biofuel stems mainly from its very high lipid content (up to 75 per cent total dry weight under controlled conditions), and its ability to grow rapidly, which means it requires significantly less land area – up to 49–132 times less – compared to rapeseed or soybean crops.³⁵ Further advantages of algae are that they can be grown on marginal land and do not necessarily require freshwater, and that the source of nutrients can be wastewater and industrial carbon dioxide. In addition, unlike first generation biofuels, the use of algae does not compete with food sources.

1. Characteristics of algae

The term algae encompass a diverse group of photosynthetic organisms. It is difficult to accurately estimate the number of species that exist worldwide, as some algae varieties are not related.³⁶ Several studies have attempted to make regional estimations. For example, there are about 1 300 species in the Australian seas,³⁷ about 20 000 around the United Kingdom,³⁸ 400 on the western coastline of South Africa,³⁹ and 435 in the Mauritian seas.⁴⁰ AlgaeBase⁴¹ is a database that provides a good repertoire of marine, freshwater, and terrestrial algae in the world, based on published information.

Algae are plant-like, often greenish, organisms that are present in both fresh and marine water bodies. They can be defined as thallophytes (plants lacking roots, stems, and leaves), which have chlorophyll as their primary photosynthetic pigment, and lack a sterile covering of cells around the reproductive cells.⁴² Algae are usually categorised into three sub-groups: cyanobacteria, microalgae, and macroalgae. Cyanobacteria are prokaryotes (lacking membrane-bound organelles), while both microalgae and macroalgae are eukaryotes (containing a nucleus surrounded by a membrane).⁴³ Cyanobacteria and microalgae are usually unicellular, but they can exist as colonies.⁴⁴ Macroalgae, on the other hand, are multi-cellular organisms that resemble the roots, stems and leaves found in higher order plants.⁴⁵

Of all the different algae, microalgae and cyanobacteria (blue-green algae) are preferred feedstocks for biofuel production, as they have the ability to accumulate lipids, also called TAGS (triacylglycerols) in their cells. Microalgae have been classified into four groups based on their pigmentation, life cycle and basic cellular structure. The four most abundant groups of microalgae, are diatoms (Bacillariophyceae), green algae (Chlorophyceae), blue-green algae (Cyanophyceae), and golden algae (Chrysophyceae).⁴⁶

The amount of oil produced depends on the species and can vary greatly, from about 2 per cent by dry weight for *Chlorellapyrenoidosa* to around 25 to 75 per cent for *Botryococcus braunii*.⁴⁷ Beyond their natural oil content, algae can be further induced to accumulate higher amounts of lipids, often greater than 60 per cent of their weight.⁴⁸ Over the last two decades, plant biotechnology and genetic engineering of microalgae have been employed to increase the oil production capacity of microalgae.

2. Biofuel production from algae

Renewable energy from algae can be harnessed in multiple ways, including biodiesel from algal oil, methane by anaerobic digestion of the algal biomass, bioethanol by fermentation, and biohydrogen by photobioreactors.^{49,50} Only biodiesel production is considered here.

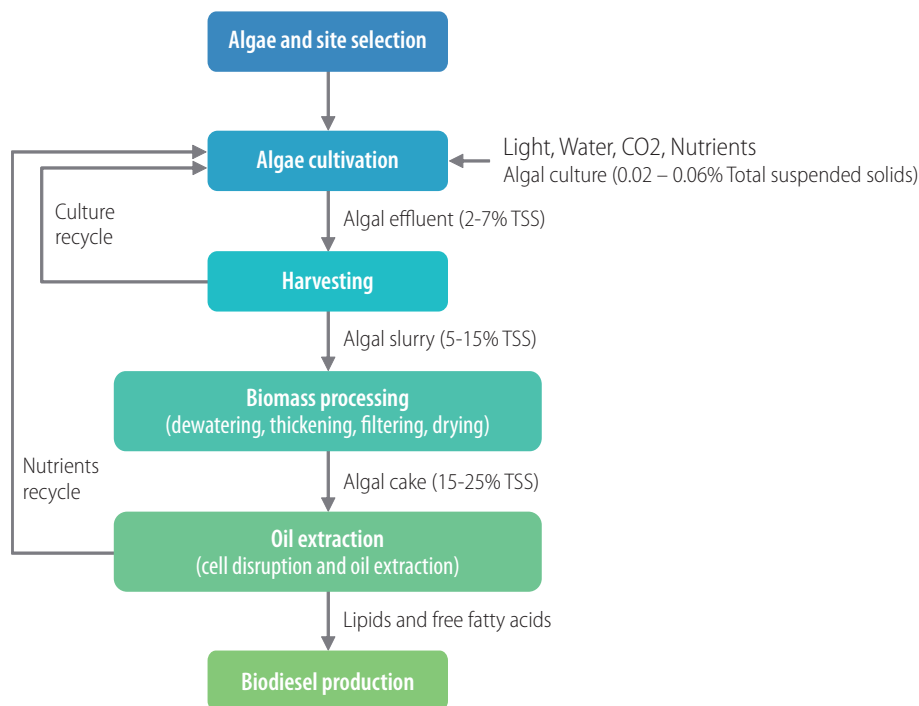
Biodiesel consists of mono-alkyl esters, such as methyl esters, produced from vegetable or animal oils through the process of transesterification (represented in the equation below). The energy density of algae is about 41 MJ/kg, which is comparable to that of petroleum diesel (42.7 MJ/kg).⁵¹



The steps involved in producing biodiesel from algae are shown in Figure 14.3.

Algae cultivation is usually carried out in open ponds or closed reactors, called photo-bioreactors. Photo-bioreactors require higher initial capital investment than open ponds, but they allow better control, and have higher productivities. Open ponds are often susceptible to contamination by foreign species, such as other microalgae or bacteria, and require more energy to homogenise nutrients.⁵² Growing algae requires light, carbon dioxide, water, and nutrients such as nitrogen (N), phosphorous (P), and potassium (K). Silica and iron, and other trace elements are also important nutrients for productivity.⁵³

Figure 14.3: *Biodiesel Production from Microalgae*⁵⁴



The most common methods of harvesting algae include sedimentation, centrifugation, filtration and ultra-filtration, and sometimes include flocculation as well. The cost of harvesting algae from a dilute culture medium may amount to 20-30 per cent of the total biomass production cost.⁵⁵ Once harvested, the algae are usually dried, and the oil is extracted through cell disruption of the microalgae cells, using mechanical methods (cell homogenizers, bead mills, ultrasound, autoclaves, spray-drying) or other methods such as freezing, solvent extraction, enzymatic and acid or alkali extraction.⁵⁶ The three most popular methods are expeller press, solvent extraction with hexane, and supercritical fluid extraction.⁵⁷ The final step consists of using a transesterification reaction to convert the oil to biodiesel (esters) and glycerol (by-product).

3. Current state of the technology and commercialisation

Producing biodiesel from algae offers many advantages, such as the rapid growth rate of algae, high per-acre yield of oil, and the production of a biofuel that is non-toxic and highly biodegradable. However, production at commercial scales remains challenging due to the high cost of investment (infrastructure) and operation

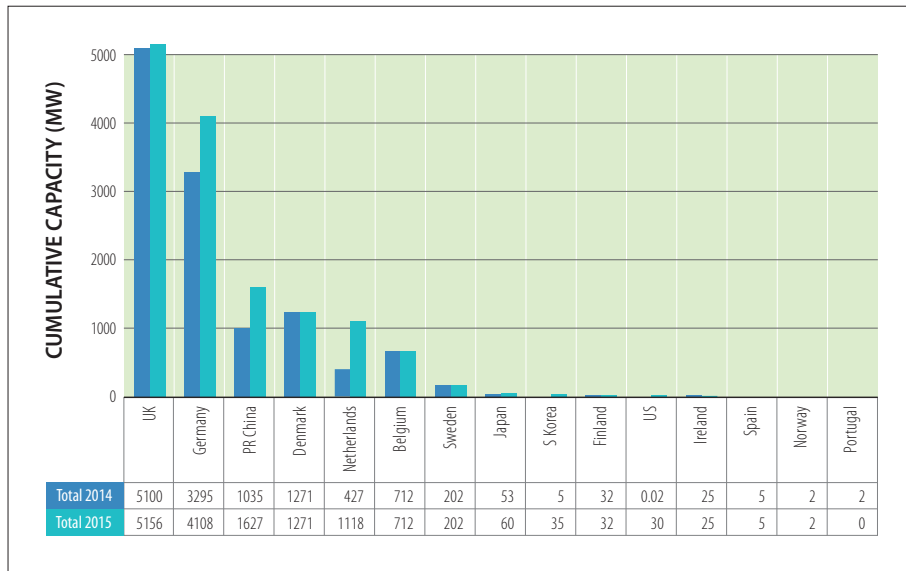
(harvesting and extraction). Several plants working towards commercial production exist around the world (in the US, Spain, Japan, Brazil, the UK, Bangladesh, India, South Africa, and more), but since the technology is still under research and development, and carries many uncertainties, it is as yet unsuitable for smaller developing countries.⁵⁸ Further research in genetic engineering (which aims to produce strains with enhanced oil yields, and ones that offer easy extraction), coupled with the use of waste carbon dioxide and wastewater as a source of nutrients (using processing based on the biorefinery concept), could make algae biofuel a viable reality in the future.

Offshore wind energy

Wind energy uses wind turbines to convert the kinetic energy of wind for power generation. Wind energy, like other renewable energy, is widely available around the world. When integrated in a country's energy mix, wind energy helps in reducing dependence on fossil fuel and increases energy security. Wind energy does not produce greenhouse gas directly, does not emit other pollutants such as sulphur or nitrogen dioxides, and does not require water. Onshore wind energy is a proven and mature technology, presently delivering electricity at a rate of US\$0.04/kWh to US\$0.09/kWh around the world, without financial support.⁵⁹ In 2015, wind energy produced about 433 GW globally, accounting for 23.4% of total renewable energy. Offshore wind energy refers to the energy generated by wind turbines installed in the sea, usually on the continental shelf. Despite the higher cost, offshore wind turbines generate more electricity because of significantly higher wind speeds at sea than inland.

Europe is the leader in offshore wind turbine research, with over 30 years of experience in the field. The first offshore wind farm was installed in Denmark in 1991, and the technology was then deployed in many parts of Europe and the world.⁶⁰ The UK, Germany, and China had the highest installed offshore capacity in 2016 (Figure 14.4). Compared to onshore turbines, offshore wind turbines differ in logistics and technology, but for enhanced production, both technologies follow the trend of longer blades, a larger rotor size and a higher hub height.⁶¹

Figure 14.4: *Global Cumulative Offshore Wind Capacity*⁶²



The design of offshore turbines is similar to land-based wind turbines, but with modifications made to account for the harsher conditions experienced in the ocean. Some of these changes comprise a stronger tower, to cope with the added load from waves, pressurised nacelles (outer casing) and environmental controls to protect the drivetrain and electrical components from corrosion.⁶³ The US National Renewable Energy Laboratory has categorised offshore wind power based on the water depth where they are installed. These include land-based, shallow water (<30m), transitional water (30-60m), and deep water (>60m).⁶⁴ Other fundamental differences between land-based and offshore turbines are their substructures and foundations systems. Monopiles are the most common substructure for depths ranging from 5-30m. For transitional water depths, multi-pile substructures such as tripods and jackets have been used, while floating wind turbines are used for deep water systems.⁶⁵

The cost of investment increases with increasing water depth. Indicative costs show that cost increases with depth; for example the cost for 10-20m deep water installations is 1800 euro/kW; it increases to 2514 euro/kW for 40-50m depths (most of the increase in cost being attributed to foundation construction).⁶⁶ Further, because these systems are not easily accessible, operation and maintenance costs can be much higher.⁶⁷ The average power produced by new turbines installed in Europe in 2016 was 4.2MW. The cost of offshore wind power is higher than other renewable energy options (US\$0.165/kwh in 2015),⁶⁸ however, this cost is expected to decrease with better design and technology.

Primary concerns regarding offshore wind power facilities include: (i) the effect on marine animal populations; (ii) visual effect on coastal communities due to a change in the seascape; (iii) effect on property values; (iv) effect of noise, principally during the construction phase; (v) impact on tourism; and (vi) marine safety issues, such as risks to the environment and to human safety in the case of fuel leaks, which may arise in the event of a ship colliding with a turbine.⁶⁹ Economic and ecological impacts of offshore wind power are site-specific, and the negative impacts can be mitigated by careful site selection, and by implementing best management practices such as avoiding areas of high biological conservation importance.^{70,71} In general, offshore windfarms are environmentally beneficial and can contribute significantly to reducing fossil fuel dependence and reducing CO₂ emissions.

Offshore photovoltaic

Energy from the sun is free, inexhaustible and available around the world, making it an important source of renewable energy. Solar energy comprises light and heat energy. Several technologies can be employed to harness them. These include solar photovoltaic (PV), solar thermal heating and cooling, and concentrated (sometimes concentrating) solar thermal power (CSP). In an hour, the earth receives about 4.3×10^{20} joules of energy from the sun, which is more than the energy consumed in a year (4.1×10^{20} J).⁷² About 70 per cent of the energy reaching the Earth is absorbed by clouds, oceans and land masses, while the remaining 30 per cent is reflected back into space.⁷³ Inland solar energy is already an important source of power and heat derived from renewable resources, accounting for 1.2 per cent of global energy production.⁷⁴ Moving to offshore solar power generation is the next logical step, considering the scarcity of land and the vast water surface.

Solar energy technologies

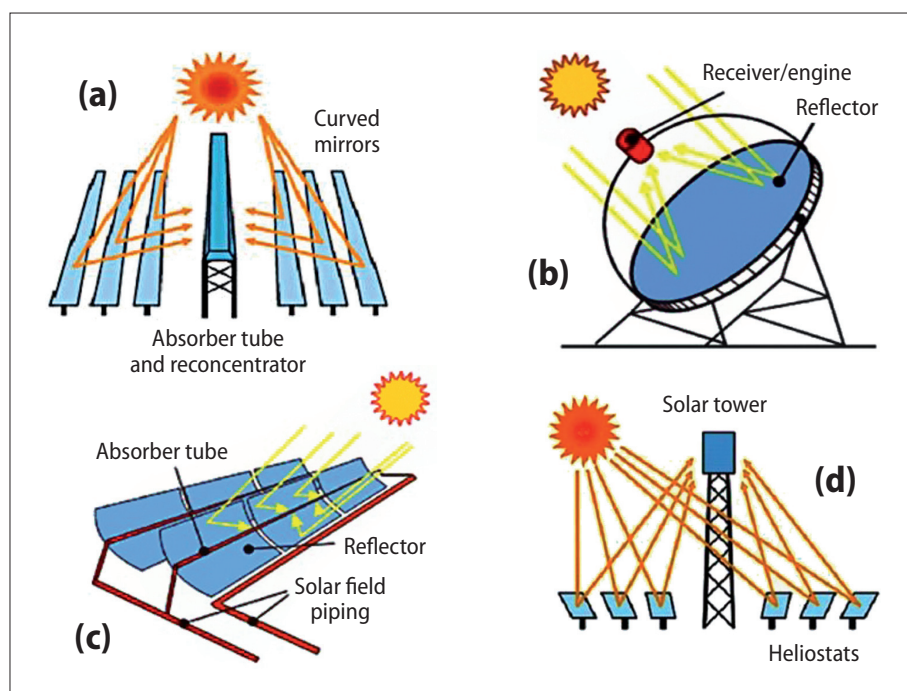
While there are no commercial offshore solar energy facilities as yet, there are several projects and much research that is looking at such a possibility in the future. Solar energy can be converted into an exploitable form of energy through various technologies. These technologies can be divided into two categories: thermal (concentrating solar power) and phototonic.⁷⁵

Concentrated solar power technology

Concentrated solar power uses lenses and mirrors to focus solar radiation into a concentrated beam. The heat in the beam is then converted into electricity by

traditional methods. The technologies that are most commonly used for concentrating solar energy are the concentrating linear Fresnel reflector, the parabolic dish, the parabolic trough and the solar power tower (Figure 14.5). These technologies are also equipped with mechanisms that allow them to track the sun. Concentrated solar power plants generally consist of two parts: the collection of the solar energy, and its conversion into heat by a heating fluid (with subsequent conversion of this heat energy into electricity by conventional technology).⁷⁶

Figure 14.5: Different Solar Energy Collecting Systems: (a) Linear Fresnel Reflector; (b) Parabolic Dish; (c) Parabolic trough; (c) Central Receiver Tower (Reproduced with permission from Kumar et al., 2015)⁷⁹



Solar photonic technology

Solar photonic technology converts solar energy by absorbing photons and directly converting them into electricity, or by storing part of the energy in a chemical reaction.⁷⁷ Solar panels consist of solar cells made of thin wafers or films, with the most predominant PV technology being made of crystalline silicon. PVs are usually easy to maintain and have a long life since they do not have moving parts. They do not generate any emissions, do not require cooling - except in the concentrator systems – and are noiseless.⁷⁸

The first documented system was implemented in May 2007 in California. Three months later, an alternative floating PV prototype was installed in Aichi, Japan.⁸⁰ Further floating solar PV projects followed, and most of the floating PV systems (98 per cent of existing capacity) were installed between 2014 and 2016.⁸¹ About 70 floating plants had been installed around the world by the end of 2016, with the biggest plant (20MW) located in China. The UK and Japan are the two leading countries in terms of this technology; the UK has six installed plants, while Japan has 45 plants installed.⁸² Onshore PVs are very competitive when compared to fossil fuels. Generally, offshore renewable technologies are more expensive than conventional fossil fuel and nuclear plants, however, the cost of electricity from offshore thin film PVs (at equatorial latitudes) is comparable to energy generated from a natural gas power plant.⁸³

Offshore PVs require a large surface area to be able to produce electricity at a large scale, and would need to be supported on equally large floating or fixed structures. The impact of such structures could potentially include interference with commercial and recreational fishing, interference with boating, surfing and diving activities, and shading of the water surface, resulting in ecosystem disturbance.⁸⁴ Other potential impacts are collisions with vessels at sea, which may result in the release of toxic compounds. However, careful planning and avoiding areas situated on ship routes, and areas already used for recreational purposes can significantly reduce the risks associated with offshore PV systems.

Ocean renewable potential and deployment in IORA member states

The Indian Ocean Rim region accounts for 15 per cent of global energy demand.⁸⁵ Access to electricity varies: countries in Asia and South-East Asia generally have over 75 per cent access, while those in Africa have between 17 per cent (Madagascar) and 86 per cent (South Africa).⁸⁶ The percentage of energy from renewable sources in the energy mix again varies from country to country.⁸⁷ The least developed countries are still lagging behind, and a large percentage of the population still rely on traditional fuel, such as wood and charcoal, for cooking and heating.⁸⁸ This results in the destruction of vital forests, including mangroves and associated ecosystems. Further, the inefficient combustion of biomass leads to indoor air pollution, causing premature deaths.

Ocean renewable energy represents an attractive source for increasing energy availability and charting a path towards energy security, especially for countries that are heavily dependent on oil and/or other non-renewable sources. Conditions in the Indian Ocean are generally favourable for the implementation of the

different technologies listed above. The biggest constraints, however, are the levels of the technology development, the cost implications, and garnering political support for investment in renewable ocean technologies (as opposed to proven, but polluting, fossil fuel technologies).

Most ocean renewable energy technologies are still at the prototype or demonstration stage. A commercial market does not exist yet, except for offshore wind turbines and tidal barrage. Implementation is often left to private entities and research organisations with limited support provided by governments. Research and development in the Indian Ocean region still lags behind. Very little data on progress made by countries in the region is publicly available.⁸⁹ Australia is the only country that has taken a significant lead in the development and implementation of such technologies. The potential and deployment status in IORA member states is discussed below.

Africa

The percentage of renewable energy in the energy mix of IORA member states on mainland Africa varies diametrically. At one end of the spectrum, Somalia does not depend on renewable sources at all, while at the other end, Mozambique obtains 91% of its energy from renewable sources.⁹⁰ South Africa, which has the highest percentage access to electricity in the region, obtains only 1.4 per cent from renewable sources. Among the island states Madagascar, with 50 per cent, has the highest proportion of electricity from renewables (even though access to electricity is only 17 per cent), followed by Mauritius, which reports 20 per cent renewables, while the Seychelles has 2.1 per cent, and the Comoros has no renewables in its energy mix.

Countries in Africa have extensive coastlines,⁹¹ with a stretch of 10 253km from South Africa to Somalia, and Madagascar alone has 4 828km. The island states have vast expanses of exclusive economic zones that could be exploited for marine renewable energy. Conditions in the western Indian Ocean⁹² are generally suitable for most forms of marine energy (Table 14.2).

Table 14.2: *Resource-Based Potential for Different Forms of Ocean Energy in the Western Indian Ocean: H = high resource potential; C = conditional resource potential; N = northern monsoon; S = Southern monsoon*⁹³

Region	Wave Power	OTEC	Tidal Barrage	Tidal Current	Ocean Current
Kenya	–	–	–	H	C (S)
Seychelles	C	H (N)	–	–	–
Tanzania-Zanzibar	–	–	–	H	–

Region	Wave Power	OTEC	Tidal Barrage	Tidal Current	Ocean Current
Southern Tanzania	–	C (N)	–	–	–
Comoros and Mayotte	–	H (C)	–	–	–
Northern Mozambique	–	H (N)	C	H	C (N)
Central Mozambique	–	–	C	C	–
Southern Mozambique	H (S)	–	–	C	–
Western Madagascar	H (S)	–	C	–	–
Eastern Madagascar	–	C (N)	–	–	–
Southern Madagascar	H (S)	C (N)	–	–	–
Mauritius	H (S)	H (N)	–	–	–

There are already several projects, mostly at the experimental and pilot stage, being implemented in the region. WERPO, an Israeli wave energy developer, is implementing a 500MW wave power plant in South Africa⁹⁴ and a 100MW plant in Kenya.⁹⁵ In Mauritius, Carnegie Wave Energy Ltd., an Australian company, is building a 1-5MW renewable energy micro-grid that will be powered by ocean renewable energy and which can also desalinate water.⁹⁶

Middle East

In the Middle East, the energy mixes of Oman and Yemen do not include renewable energy sources, while the United Arab Emirates obtains a mere 0.27 per cent of its electricity from renewable sources. However, the latter plans to invest US\$163 billion in developing renewable energy sources, to provide about half of its energy demands, by 2050.⁹⁷ Solar energy will account for most of the renewable energy. In fact, the potential for exploiting ocean energy is relatively limited in the Middle East, while other sources, such as wind and solar, appear to be more viable.

Iran, at 5.2 per cent, has the highest regional percentage of renewable energy in its energy mix.⁹⁸ For a long time, hydropower was the dominant source, but recently European companies have invested in solar, wind, and geothermal technologies.⁹⁹ Studies to assess the potential for exploiting ocean and lakes appear promising but further research and pilot plants are required to determine the full potential and commercial viability.¹⁰⁰

Asia

Among the IORA member states in Asia, Sri Lanka has the highest percentage (39 per cent) of renewable energy for electricity generation in its energy mix, while India has 15 per cent. In Southeast Asia, only 1.7 per cent of the electricity used in Singapore originates from renewable sources, while in Malaysia, Thailand, and Indonesia it is about 10 per cent.¹⁰¹ Ocean renewable energy in the region can both increase access to electricity and diversify the energy mix.

Studies conducted on the potential of the different forms of marine energy in Southeast Asia revealed that Indonesia, given its location and geographical extent, and length of coastline, could benefit greatly from tidal, wave, and OTEC.¹⁰² On the other hand, wave data around Malaysia, shows that it has only limited potential for wave energy,¹⁰³ but research into the identification of suitable sites for tidal energy and OTEC are ongoing. In Thailand, the potential for wave energy is also very limited, but research is being conducted to identify sources and the most appropriate technology to use.¹⁰⁴ Singapore has the potential for a 250MW tidal energy plant, and can also extract 100gigawatt hours per year from the salinity gradient between saltwater brine from desalination plants and waste from its government-owned NEWater plants.¹⁰⁵ The latter are water recycling plants that purify treated wastewater through membrane technologies, to produce potable water.

With a coastline of 7 000km, India can greatly benefit from ocean renewable energy. Numerous studies, using observed data and models, have been conducted at the Indian Institute of Technology, Madras, and elsewhere, to identify suitable locations and technology. Over 11 000MW from tidal energy and 41 000MW of wave energy can be extracted.¹⁰⁶

Australia

Electricity from renewable sources accounts for 15 per cent of the electricity consumed in Australia.¹⁰⁷ Despite already having an abundance of both fossil and renewable sources of energy, Australia is looking at the ocean for sources of energy to diversify its energy mix. Of all the countries in the world, Australia probably has the highest potential for wave energy. Recent estimates show that the total wave energy available along the Australian coast, based on fluxes across the 25, 50, and 200m contour, is 1 796, 2 652, and 2 730 Tw/yr, respectively.¹⁰⁸

The Australia Renewable Energy Agency¹⁰⁹ (ARENA) has been set up to accelerate the development and implementation of all the different types of renewables, including ocean, in the country. ARENA has invested significantly in several wave energy-related projects. Carnegie Wave Energy Ltd. and BioPower Systems have successfully developed and demonstrated technologies that can harness wave

energy. Off the coast of Garden Island, Western Australia, Carnegie is currently implementing a project that relies on a buoy that oscillates with ocean waves to produce energy, which will generate up to 3MW. It is also developing technologies that can both produce energy and desalinate water. These can benefit small islands or coastal regions that have limited access to both energy and water. BioPower is implementing a different technology to convert ocean wave energy into electricity in Port Fairy, Victoria.

Conclusion

The ocean represents a vast source of renewable energy. It provides countries that have access to the ocean, and those that have an extended exclusive economic zone, with an avenue to extend their renewable energy base and minimise their dependence on fossil fuel, which can also result in long term economic benefits. Energy from the ocean can be harnessed in multiple ways, ranging from conversion of kinetic energy of the waves and tides, and salinity gradient into electrical energy, to the cultivation of algae biomass for conversion into biofuels. The ocean also provides the real estate for the construction of offshore wind and photovoltaic farms.

IORA country members have access to long coastlines and the open ocean through their exclusive economic zones, and could benefit greatly from ocean renewable energy. IORA country members are at different stages of research, development, and implementation of ocean renewable technologies. Australia is leading the pack in terms of both investment in research and the construction of pilot plants.

Around the world, tremendous progress has been made in research and development, and several pilot plants have been constructed to demonstrate the potential for harnessing energy from the ocean. Given the treacherous nature of the ocean, implementation of these technologies on a large commercial scale can be extremely costly. Furthermore, just like earth based systems, they each have an impact on the ecosystem. Therefore, it is imperative that countries that wish to embark on the implementation of such systems carefully select the technology that they wish to adopt, and assess its economic and ecological impact, to ensure long term sustainability.

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SECTION IV

Climate Change, Environmental Protection and Technology

Climate Change and the Blue Economy of the Indian Ocean

Charles S. Colgan

Introduction

The 'Blue Economy' is a term that is rapidly spreading around the Indian Ocean region, and the world. It is used to describe opportunities to use ocean and coastal resources to spur economic development and growth in a sustainable manner. Opportunities in fisheries, aquaculture, maritime transport, tourism and minerals have been identified by countries throughout the region as having significant economic potential, and policies directed at building on this potential (while increasing efforts at sustainable management of resources) are being expanded or developed.

But this attention paid to the oceans comes at a perilous time for the very resources upon which so much hope is being placed. Climate change is already affecting the oceans in many ways, and the effects are expected to intensify and expand in the decades ahead. Great plans and investments are being contemplated for oceans and coasts that will, in all likelihood, not exist in their current form within the expected life-span of those investments and plans.

These coincident trends of the Blue Economy and the consequences of climate change have both received significant attention on their own, but the attention has largely transpired in parallel discussions. The intersection between the Blue Economy and climate change has received little attention and will require reconsideration of major parts of Blue Economy development strategies, and redefinition of the elements of the Blue Economy itself. It will also require a commitment to developing ways to systematically monitor and understand the interactions as they evolve, because the view today is still too constrained by risk and uncertainty.

This paper undertakes a preliminary examination of these intersections as they apply to the Indian Ocean region. Attention to ocean-based economic development

is widespread in the region, but it is still in the early formative stage in most countries.¹ There is still time to incorporate the implications of climate change into evolving Blue Economy policies, but an understanding of the threats, limitations and opportunities created in the Blue Economy is critical.

To examine the implications of climate change for the Blue Economy in the Indian Ocean region, it is first necessary to outline the major elements of the effects of climate change in the ocean and coastal regions in general. The question then becomes how such changes will be reflected in the Blue Economy. This is both a question of how generalised effects that can be foreseen at this stage are to be measured, and how the impact of climate change on the Blue Economy could be identified and tracked. A preliminary identification of some of the policy choices created by climate change is then presented.

It should be noted that climate change's impacts on the region will extend well beyond those described here. Changes in weather and hydrology will alter agriculture and urban areas. Sea level rise will disrupt far more than the Blue Economy, with whole urban regions and even nations at risk. The focus on the relationship between climate change and the Blue Economy is directed at the implications for the development efforts for the Blue Economy; the larger issues of climate change and the Indian Ocean region need to be addressed elsewhere.

Climate change and its consequences

Understanding climate change and its effects is an exercise in resolving a fundamental paradox. The consequences of adding greenhouse gases to the atmosphere in quantities well beyond naturally occurring levels are relatively simple. The physics and chemistry are straightforward. But at the planetary scale, there is great complexity in the interaction of atmospheric and ocean circulation systems. Global average changes can mask significant regional and local variations. Even worse, most of the pace and degree of change is driven by decisions about human action to reduce the emissions of the greenhouse gases and to take other steps to reduce the damage caused by changes in the climate. Put another way, we know that the oceans will become warmer and expand. How much they will warm and expand is a matter of deep uncertainty.

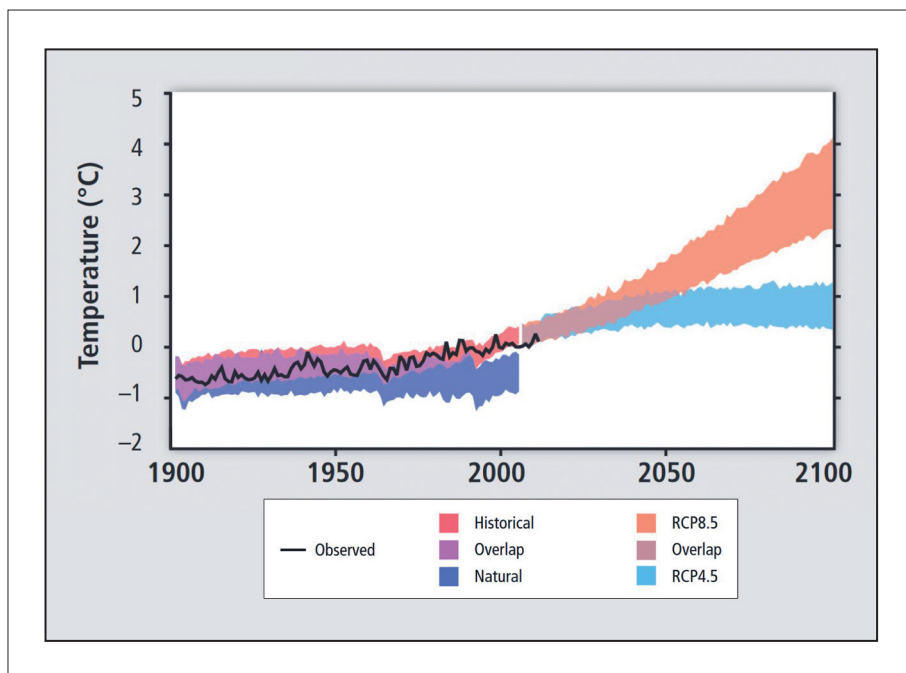
The general parameters of climate change are well established, due in large part to the United Nations Intergovernmental Panel on Climate Change (IPCC). Through five assessment reports, the IPCC has provided both global and regional assessments of climate change and its impact and has identified both the range of possibilities and the extent of scientific consensus that exists regarding the analysis and conclusions presented. Based on the analyses summarised in the

IPCC assessments, there are two major effects on oceans that are of major concern: warmer waters and changes in ocean chemistry:^{2,3}

1. Warming waters

Almost all the heat trapped in the atmosphere because of greenhouse gas emissions is being retained in the oceans, in part because the oceans cover most of the planet and in part because water is capable of changing temperatures more easily than land. The Indian Ocean, as a whole, has warmed by about 0.5°C over the period 1950-2009, with an increase of nearly 0.9°C in the warmer months. The temperature of the Arabian Gulf, has increased by 0.6°C overall, but the warming has been less pronounced in the summer months (0.3°C) since the Arabian Gulf is already the warmest of the seas. The IPCC projection is that the Indian Ocean will warm by an additional 1°C to 4°C through the end of the century depending on whether emissions are stabilised (lower projection) or not (upper projection) (Figure 15.1).

Figure 15.1: *Indian Ocean warming projections*⁴



The effects of warmer waters are three-fold: changing water temperatures change habitats for living resources; warmer waters expand, causing sea levels to rise and threaten an additional increase in sea level due to melting glacial and

polar ice caps; and the ocean-atmosphere interface is altered, which changes weather patterns and, generally, leads to increased precipitation.

2. Changes in ocean chemistry

About 30 per cent of the additional carbon dioxide emitted into the atmosphere is being dissolved into ocean waters, which changes the chemistry of the water, reducing the pH (that is, increasing the acidity) of the water.⁵ Ocean acidification will alter several physical and biological processes, affecting the composition and distribution of plankton, and indirectly, the higher trophic levels on which human fisheries depend. Salinity will also increase, enhancing more saline waters and decreasing salt in less saline waters. This will affect the hydrological cycle of evaporation and precipitation, altering weather patterns. There are also expected to be changes in dissolved oxygen that may affect nutrient cycles and upwelling patterns.

The IPCC assessment reports high confidence that these trends will continue and intensify, though with regional variations. The result, according to the IPCC, can be stated with high confidence:

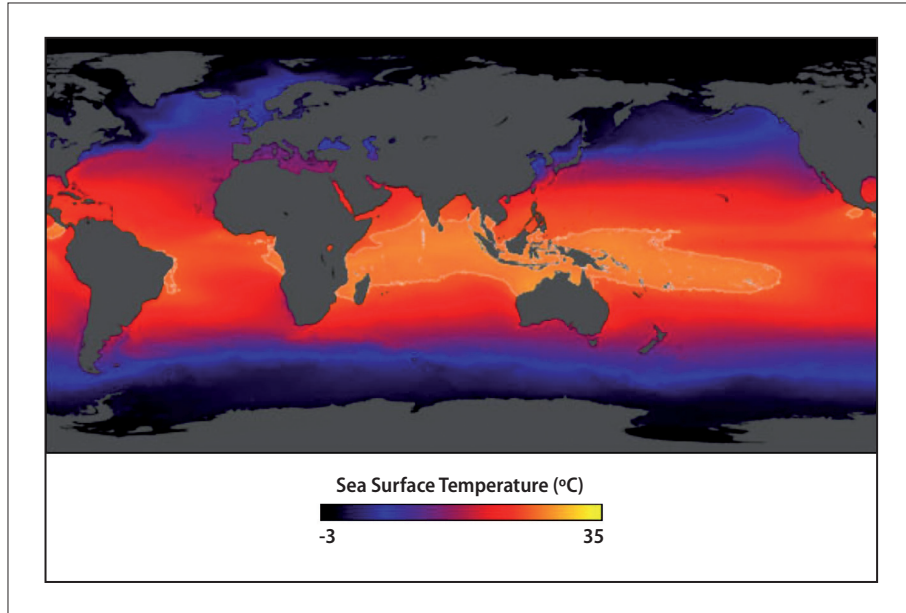
Global warming will result in more frequent extreme events and greater associated risks to ocean ecosystems ... In some cases (e.g., mass coral bleaching and mortality), projected increases will eliminate ecosystems, and increase risks and vulnerabilities to coastal livelihoods and food security.⁶

These effects will be felt throughout the world's oceans, but at different intensities. Lying almost entirely between the Tropic of Capricorn, at 23°27' south, and the Tropic of Cancer, at 23°27' north, the Indian Ocean is the warmest of the world's principal oceans. One of the Indian Ocean's key features is the Indo-Pacific warm pool (Figure 15.2) - a belt of very warm water that extends across the entire Indian Ocean and into the Southwestern Pacific. This region of warm water interacts with the atmosphere in complex ways that drive weather in the region, affect the ecosystems of living resources, and shape the direction and potential of sea level changes.⁷

Given the size of the Indian Ocean region and the complexity of climate change, it is not practical to examine all the possible relevant interactions between the climate and the Blue Economy. But two broad categories of effects can be explored: those on living resources and on coastal systems. Most of these effects are threats to the viability of extensive growth in the Blue Economy, but there are also some opportunities created which need to be identified. It is also the case that both the threats and opportunities are greatly influenced by the fact that most of the Indian

Ocean region is comprised of low income countries with meagre resources to manage the threats or seize the opportunities.

Figure 15.2: *The Indo-Pacific warm pool⁸*



Living resources

Even small changes in ocean temperature and chemistry can greatly alter the distribution and composition of fisheries and other living resources, such as coral reefs. Such changes are a significant threat to the Indian Ocean, which, along with the southwestern Pacific, accounts for more than half of the world's capture fisheries. Asia, including the Asian countries of the Indian Ocean, account for more than four-fifths of the world's fish harvesters and farmers. The African countries of the Indian Ocean do not comprise nearly as much of the world's fisheries or aquaculture output, but fisheries and aquaculture provide up to two-thirds of the protein intake of African countries.⁹

Fisheries and aquaculture will be altered partly by geographic shifts in fish stocks and partly by changes in population sizes. These alterations may occur because habitat conditions, such as temperature, change, or because of changes in lower trophic levels (plankton) that provide food for the commercially important species. The alterations may reduce population sizes or shift the populations beyond the range of fish harvesters. This is a particular issue for small scale fisheries (SSFs), which are conducted in nearshore coastal waters, either from shore or

from vessels with limited range, but it can apply to virtually all fisheries.¹⁰ Shifts in fishery ranges can also affect aquaculture, as much of the wild fish caught in the Indian Ocean is feed for aquaculture.¹¹ These climate-related stressors on fisheries and aquaculture must also be seen in the context of the human-induced stressors, which are already straining the Indian Ocean's fish stocks and their ability to provide food for humans and cultured species.

The other major living resource that will be significantly affected by climate change is coral reefs. Coral reefs grow in warm waters, but only tolerate a narrow range of temperatures. Warming waters, together with an increasingly acid chemistry, result in bleaching, killing the coral and eliminating the habitat for other species that depend on the reef as habitat. Coral reefs are a major feature throughout the Indian Ocean, particularly in the 'coral triangle' of the south-eastern portion of the Ocean, and in the mid-ocean archipelagos of Mauritius, the Seychelles and the Maldives. The reefs are a major source of food, as well as a foundation for the tourism industry, on which these and other coastal regions depend for a significant share of their national income. There has already been significant damage done to coral reefs by the changes already taking place. While coral reefs have some ability to recover from the effects of warmer waters if cooler temperatures recur, the overall pattern of steadily warming waters will reduce and eventually eliminate recovery potential.¹²

Sea level rise and coastal systems

The coasts of the Indian Ocean, and all other oceans, will be altered by climate change in ways that mean that the shorelines of today will be largely unrecognisable within a century. The principal change agents will be a rise in sea level and increased flooding from riverine systems. The principal effects will be increasing frequency, extent, and depth of flooding events and, in many places, complete inundation of shorelines. Intermittent flooding will be driven largely by tropical cyclones, which will tend to increase in both frequency and strength over time. Cyclones will produce more precipitation that will be carried to coastal areas through the region's rivers. Thus, coasts will experience more damage in the form of higher storm surges, and in the form of river flooding.

The IPCC report forecasts sea level rise in the Indian Ocean between 200 cm and 700 cm through 2100 cm (measured in the Bay of Bengal).¹³ But there is considerable variability. Recent research indicates that the northern parts of the Indian Ocean have seen higher rates of sea level rise (the Arabian Sea, and Bay of Bengal) than had previously been recorded because of shifts in wind patterns.¹⁴ Sea level rise is also projected to be higher than average in the south-east around Sumatra and Java.¹⁵ This is also the case with the islands sitting in the middle of

the Indo-Pacific warm pool, such as the Maldives and the Seychelles, for which sea level rise at the highest project levels poses existential risks.¹⁶ The African shore is expected to experience a rise in sea level that is roughly consistent with the Indian Ocean average.¹⁷

Projections of sea level rise portray the process as having a steady linear progression, but the effects of sea level rise will be most prominent when combined with storms, which occur irregularly, and, in the long term, unpredictably. Sea level rise will intensify the effects of wind-driven waves during storms and, more importantly, storm surges, which is the main cause of flooding. The inclusion of waves and storm surge could effectively double the effective size of sea level rise in storm events, particularly in tropical zones such as the Indian Ocean.¹⁸

The current and projected rates of sea level rise in the Indian Ocean are somewhat lower than in other oceans, but this somewhat smaller rise presents amplified risks because the shores of the Indian Ocean are among the most vulnerable to flooding. This vulnerability arises from four factors:

1. Low lying coastal areas, particularly in the large estuary systems of Bangladesh and India, and the small island states of Mauritius, the Maldives, and the Seychelles.
2. Large urban agglomerations lying in the floodplains, for example Dhaka, Mumbai, Kolkata, Kuala Lumpur, and Jakarta.
3. Inadequate infrastructure in the urban regions.
4. High densities of largely poor populations.

Preparing for climate change involves reconciling information about the direction of change with the lack of information about the speed of change, and the fact that the effects will be highly variable seasonally, inter-annually, and spatially. Weather events may be more severe in some years, and less severe in others as natural cycles such as the El Nino-Southern Oscillation (ENSO) cycle interact with a changing climate.^{19,20} Fisheries may see a severe drop in abundance in some years, followed by a recovery, while the trend over time is a gradual shift in populations in response to warmer waters.²¹

In short, whether it be warming waters, sea level rise, ocean acidification, or other effects, the hallmark of climate change will be increased volatility in all systems (social and natural) that are affected. This implies significantly increased uncertainty about what to do in response to climate change, and when to do it. Climate change therefore lies in the background of any study of the Blue Economy and will shape it as it develops.

Relationships to the Blue Economy

Responses to climate change are generally divided into two broad categories: *mitigation* and *adaptation*. These terms are widely, but not always consistently, used to mean *reducing the likelihood or extent of climate change* and *adjusting activities to account for the known effects of climate change*, respectively. For the purposes of this discussion, mitigation will mean the former and adaptation the latter. Mitigation and adaptation provide the foundation on which the effects on the Blue Economy can be evaluated.

These effects can be broadly grouped into three categories. First, existing resources will be disrupted and will alter both production processes and markets. Second, existing industries will take on new roles in terms of mitigation or adaptation. Finally, new economic opportunities will be created. Together, the responses to climate change and the specific changes in the Blue Economy can be mapped as in Table 15.1.

Table 15.1: Climate change responses and changes in the Blue Economy

		Responses to Climate Change	
		Mitigation	Adaptation
Changes in the Economy	Resource Disruption		
	New roles		
	New opportunities		

Table compiled by author

The model in Table 15.1 can be applied to the individual components of the Blue Economy. To be sure, there is a great deal of discussion about which sectors, industries and economic activities comprise the blue (or ‘ocean’ economy), with nations adopting different definitions based on industrial taxonomies, data collection systems, and choices about which stages of the value chain to include or exclude.²² For exploratory purposes, linking this model to the Blue Economy can be done by dividing the Blue Economy into four groups:

1. *Primary Impact Sectors*: Three of the generally recognised sectors of the marine economy illustrate how this model can be applied. These are living resources (fisheries and aquaculture), tourism & recreation, and marine construction.
2. *Cross-Cutting Sectors*: Two other widely recognised sectors, marine transportation and ship & boat building, illustrate cross-cutting relationships between

sectors. Climate change effects on the first group of sectors will require responses in these sectors as well.

3. *New Sectors:* A great deal of attention is being focused on the concept of 'blue carbon' as a way to reduce total carbon dioxide in the atmosphere by taking advantage of the ability of coastal ecosystems such as mangrove forests, seagrasses, and coastal wetlands to reduce carbon from the atmosphere.^{23,24} Blue carbon represents a new concept of economic value derived from the oceans.
4. *Minerals:* These include offshore oil and gas and offshore hard minerals embedded in polymetallic nodules, and they present special cases. Offshore oil and gas will be greatly affected by global and national decisions about the pace of substitution away from fossil fuels as a key strategy in reducing the extent of climate change. The offshore hard minerals industry has yet to become operational and its characteristics remain unclear. Because of these larger issues, the model may not be appropriate at this time.

Primary impact sectors

Living resources

The principal threat to fisheries and aquaculture arises from changes in ocean temperature and chemistry, which will disrupt the geographic distribution and abundance of both fisheries and supporting ecosystems. In general, fisheries will shift away from waters that exceed species-specific thresholds, or, as is the case with coral reefs, may experience large scale mortality. The resulting disruption in supply will reduce output in the resource related sectors, including food production and tourism.

The major challenge for living resources is clearly adaptation. The response of fish harvesters will depend on mobility and technology. Mobility is the ability to shift effort to where the fish stocks have moved. Technology is a shift in the mode of fishing to take advantage of under-used or new species. There will be significant differences among fisheries. Larger scale, capital-intensive fisheries that use larger vessels may be able to shift location or alter technologies, while small scale, subsistence, and coastal fisheries' mobility and innovation potential ranges from non-existent to minimal. This is even more of a problem in small scale fisheries associated with coral reefs, which are vulnerable to change from both temperature and acidification.²⁵

If it is possible to culture species with higher temperature tolerances, the adaptive potential of aquaculture may be higher than capture fisheries, though questions about food supply for aquaculture from capture fisheries remain. Shellfish aquaculture, notably shrimp, will see significant threats from ocean acidification, which inhibits shell formation.^{26,27}

Of equal concern to the effects on the fishing industries are the changes that will flow through to fisheries markets. The significant role of fish protein in diets, notably in Africa, will create a challenge for both land and sea-based food production and the distribution channels on which they depend. Competition between fish caught for aquaculture feed and for human food may emerge.²⁸

Combined, these various effects of climate change will alter the ways in which the fishing industry and fisheries are regarded. The principal issue for fisheries historically has been over-fishing - extracting too many fish from the ecosystem to ensure sustainable marine populations. Until now, the challenge for the Blue Economy has been to better match fishing efforts and fish populations. Fisheries management has focused on limiting harvesting levels and, increasingly, on protecting areas of the ocean from fishing, through devices such as marine protected areas (MPAs).²⁹ MPAs are increasingly utilised around the world, including in the Indian Ocean.³⁰ Climate change challenges all the assumptions underlying these approaches. Catch plus habitat changes may result in fisheries declining faster than managers can respond. Furthermore, MPAs that are based on one understanding of fish distribution may become irrelevant if fish stocks shift geographically.

Fisheries and aquaculture are relatively small industries in terms of energy use compared with other sectors, but as the phase out of fossil fuel use (required for meeting climate goals) proceeds, the living resources industries will come under increased scrutiny for mitigation. Emerging evidence about the use of fossil fuels in capture fisheries indicates that the type of species and type of gear related to the fishery are the principal determinants of fuel use, and thus of greenhouse gas emissions.^{31,32} This would suggest that adaptive gear switches necessitated by shifts in fish stocks due to temperature and chemistry changes may conflict with mitigation goals. At the same time, there is some evidence that fisheries that are operating more closely within sustainable limits are also more fuel efficient because the need to search for fish is reduced.³³ There is also a great deal of interest in assessing greenhouse gas emissions over the life cycle of fisheries and aquaculture for comparison with other food sources, though little of this research has been produced in the Indian Ocean region.³⁴

Tourism and recreation

Coastal tourism and recreation is generally a small component of the Blue Economy in most of the Indian Ocean region, except in the small island developing states in mid-ocean, where it is critical. For this sector, there are three major vulnerabilities created by climate change. One is loss of coral reefs from warming and acidification, the second is loss of beaches and other shoreline features from sea level rise, and the third is the loss of shore side facilities both private (resorts, hotels, etc.)

and public (roads, marinas, etc.). While adaptation in fisheries is largely a matter of shifting activity as the resource changes location or abundance, tourism is highly location dependent. The principal adaptation strategy, therefore, will be to find ways to keep tourism viable despite changes in the resources and locations that make tourism possible.

For this purpose, adaptation will be comprised of various mixes of protection of existing assets, such as using barriers between shore and sea, moving built structures away from the shoreline, or artificially maintaining natural features such as beach nourishment. This is a complex choice. Seawalls built to protect a road, vacation homes or a hotel will likely result in a loss of shoreline, including beaches, as local hydrodynamics change. Retreat from the shore minimises the threat of damage and preserves natural features that attract tourists in the first place; but it reduces the attractiveness of a location compared to other areas that can offer beachfront accommodation. Artificial reefs or beach nourishment may provide adequate substitutes for natural features but can only be formed and maintained through substantial expenditures, which tourist fees may or may not adequately cover.

If barriers are to be created between the sea and shore, an additional set of issues related to tourism will arise. The defects of engineered structures that act as a barrier have led to greater attention being paid to 'natural' or 'green' solutions to flooding.^{35,36} This approach utilises natural features such as wetlands (including beaches), coral reefs, and mangrove forests as defences against flooding. Such natural systems are generally more capable of reducing the size and destructiveness of storm surge because they provide a dynamic barrier against flooding that can absorb flood damage and recover through natural processes. Such natural infrastructure may be maintained by conserving existing areas whenever possible, or by working to restore natural systems that have been transformed through development or deterioration. Climate change adaptation will thus alter decisions involving development and conservation of shorelines throughout the Indian Ocean, in the sense that conservation of shorelines may become the most important strategy for development of tourism.

The mitigation issues surrounding tourism and recreation in one sense occur in the energy use of tourism facilities themselves, and this is not an issue distinct from overall mitigation efforts in built environments. However, the mitigation issues likely to have significant effects on Indian Ocean tourism lies in the transportation sector, particularly in the air transport and cruise ship industries. Both these transportation modes are known to be significant greenhouse gas emitters, but strategies for reducing emissions are only now being formulated. Addressing emissions from air transportation and cruise ships is largely a matter beyond individual national actions, though local efforts to reduce fossil fuel use for cruise

ships when in port may contribute to mitigation. It is clear, however, that these two transportation sectors, which are so critical to ocean tourism in the Indian Ocean, are confronting major mitigation issues.³⁷

Marine construction

Marine-related construction has usually been defined as the construction and repair of facilities such as docks and wharves, as well as dredging of harbours and installation of facilities such as oil and gas platforms. It is a highly specialised type of heavy construction. But as the previous discussion suggests, perhaps the most significant new role for marine construction will be in the construction of adaptation measures, particularly to address flooding and sea level rise. This will include such traditional structures as sea walls, but it will also need to include efforts to restore wetlands, beaches, and mangroves as part of the efforts to create natural infrastructure for flood protection and for other co-benefits.

The climate change adaptation aspect of construction needs to extend beyond traditional concepts of 'marine'. Throughout the Indian Ocean region, major investment in buildings and infrastructure are needed, including for water management and transportation. In coastal areas, these investments will often require modification to address climate change impacts. Sewer systems will have to separate sanitary and storm sewers and be located so as to minimise damage from storm surges and a rise in sea level. Storm sewers designed to handle precipitation levels beyond historical levels will have to be built. Roads will need to be designed to accommodate increased precipitation and storm surge through larger culverts or elevated roadways. Buildings in the flood plain may need to be elevated or reinforced to reduce the possibility of flood damage.

These increments to building and infrastructure investments are likely to represent a substantial portion of adaptation expenditures in many countries. When they take place in coastal areas, with the purpose of addressing potential threats from sea level rise, they may be considered part of the Blue Economy's climate change adaptation components.

Cross-cutting sectors

Marine transportation; ship and boat building

The marine transportation sector illustrates how the various elements of climate change affect cross-cutting sectors. Both the adaptation and mitigation elements of climate change affecting marine transportation have been outlined in the previous section. Shore-side infrastructure for ports needed to accommodate sea level

rise, both for cargo and passenger elements, are part of the infrastructure issues that must be addressed by the marine construction sector. Emissions issues related to both passenger and freight transportation have been identified as important global mitigation issues. Passenger transportation, whether cruise ships or local and regional ferries, are important elements of the tourism and recreation sector.

Ship and boat building is another cross-cutting sector. The issues for the shore-side facilities used by this sector, with respect to sea level rise and coastal flooding, are similar to those in marine transportation in general. In both cases, the strategies of building barriers to flooding are of very limited value since fixed structures would limit the mobility required for ships. Over time, both ports and ship building facilities will need to be re-engineered to accommodate sea level rise, through a combination of flexible shore-side structures and a shifting of some facilities away from the shore altogether. Local circumstances of shoreline configuration, tides, and vulnerability to flooding will shape the responses in each case. Boat building (that is smaller vessels) may have to shift away from the shore almost entirely, requiring new investments in transportation for moving completed or nearly-completed vessels.

Cargo ships, with their very high weight per unit of energy, are efficient, but, on aggregate, still comprise a major source of emissions. There is thus a need to reduce greenhouse gas emissions from ships and boats, which in turn creates the need for significant innovation in terms of hull design, vessel propulsion systems and vessel management.³⁸ This is a challenge that ship and boat builders around the world will have to overcome. Significant competitive advantage in this global industry is possible, if ship and boat builders in a region are able to develop and deploy technologies that significantly reduce emissions.

New sectors

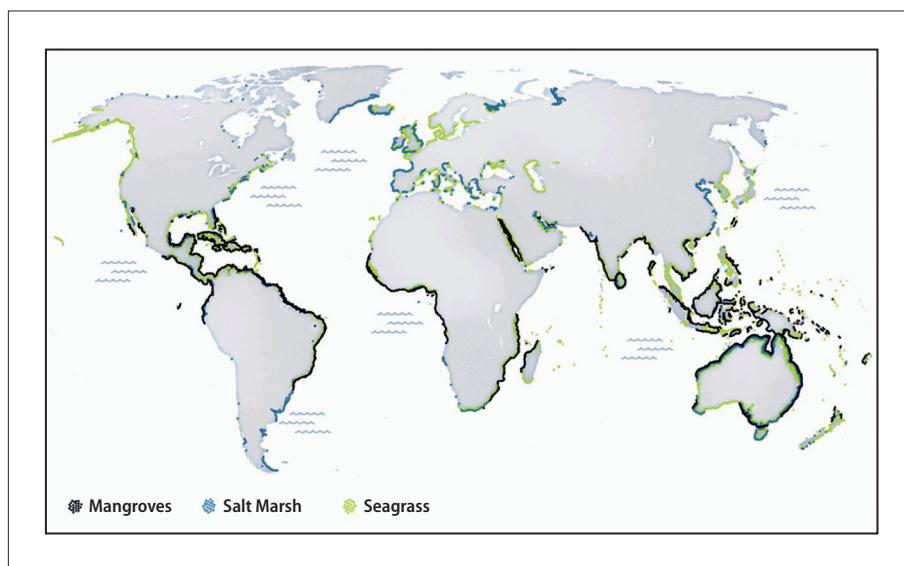
Blue carbon

As noted earlier, the oceans are the repository for most of the carbon dioxide emitted into the atmosphere. The effects of this in terms of warmer waters and changing ocean chemistry have been noted above, but there is a positive side to the ocean's carbon storage ability. Certain coastal ecosystems, including wetlands, mangroves, and sea grasses perform essentially the same function as forests, removing CO₂ from the atmosphere in exchange for returning oxygen to the atmosphere. The carbon stored in the plant fibres of these ecosystems, including the decomposed plant material in the soils, reduces the total greenhouse gases in the atmosphere. This basic fact of biochemistry transforms what had previously been considered waste lands into potentially valuable resources.³⁹

The Indian Ocean has significant blue carbon potential in the areas of the eastern shores of the Arabian Sea, the Bay of Bengal, the African and Madagascar coasts, and the north-western coasts of Australia (Figure 15.3). Mangroves and wetlands are also important ecosystems as fishery nursery habitats, and can also play an important role in flood protection. Blue carbon benefits, when cumulated with these other benefits, will make a difference in decisions about conservation and restoration of wetlands.

But to make a significant impact, the amount of coastal land providing blue carbon benefits will need to be greater than that that can be provided as incidental to other uses. Approaching the full potential benefits of blue carbon will involve development of a carbon sequestration, or carbon credits, market that would allow owners of land capable of providing carbon benefits to be paid for those benefits. Such payments would come primarily from a carbon credit trading system, in which users of fossil fuels (or other greenhouse gas emissions) would purchase offset credits to be either carbon neutral or net carbon reducing.

Figure 15.3: *Global distribution of blue carbon ecosystems*⁴⁰



Carbon credit markets are evolving around the world, although blue carbon credits are currently rare in such markets. The trading of carbon credits requires the creation of markets with supporting institutions such as legal frameworks, brokers and exchange mechanisms. These supporting activities may evolve into an economic activity at the national or regional level that will warrant inclusion in the Blue Economy.⁴¹

The Institutional Challenge of Climate Change for the Blue Economy

The fundamental idea of the Blue Economy, that ocean-related economic development is about integrating economic, environmental and social outcomes, is widely seen as the only appropriate way forward. But it is a daunting challenge in and of itself, and without taking into account the disruption that will occur as a result of climate change. The Blue Economy will not be like standard ship construction, where naval architects design the ship, builders build it and sailors sail it. It will be ship launched after only the hull has been produced and expected to be sailed without adequate charts and with most of the construction taking place under way and, as often, as not driving through (literal as well as metaphorical) storms. The challenge is to find organisations and institutions capable of manoeuvring already complex systems in a highly flexible way through difficult circumstances with high degrees of both uncertainty and volatility.

Few public or private institutions have experience in running organisations in such circumstances. Most are built on the classic rational management model of the ship: plan, build, operate. In lower income countries, where resources for public and private management are lacking, the ability to carry out the classic management process can be doubtful. But there really are no options. Using the oceans as a basis for economic development is required for many Indian Ocean countries because it is almost all they have, and for others it represents an opportunity that cannot be missed. And climate change is happening. Both mitigation and adaptation are required whether desired or not.

The question then becomes, What are the institutional changes needed to accomplish the integrated environmental-economic goals of the Blue Economy and meet the challenges of climate change? The full answer to this question is well beyond the scope of what can be covered here, but three ideas can be introduced:

1. Make systems development to measure change a high priority.
2. Replace classic management with adaptive management.
3. Greatly expand cooperation – both formal and informal.

Measuring the Blue Economy under climate change

Developing and maintaining the means to measure socio-economic and environmental changes in ocean-related systems is critical for understanding, and responding to, the nature of the changes that are desired as part of the Blue Economy and which are imposed by climate change. This requires investment in

environmental monitoring, such as ocean observation systems, as well as reform in standard economic statistical systems to integrate economic and environmental changes.⁴² The framework for this integrated measurement is provided in three statistical standards developed by the UN:

The *System of National Accounts* (SNA) provides the standards for the creation of national income and product accounts, which yield measures such as the gross domestic product (GDP). GDP is the measured gross output in the economy for any given period and is the most common measurement of the levels of economic activity. Standard economic data series can be configured to create ocean economy accounts that focus on the outputs of key industries.^{43,44,45}

The *System of Economic and Environmental Accounts* (SEEA) adds two additional components to national income accounts. One is a capital account for natural resources such as fisheries and minerals. The capital account measures the stock value of a resource, which is the present value of the income that could be earned from that resource over a specified period. The measurement of stocks depends on physical measures such as the biomass added and subtracted. Economic accounts add the prices of the units in the physical stocks to measure the changes in economic value as influenced by markets. The SEEA also includes the value of expenditures on environmental and resource management, by both private and public organisations. Identifying these expenditures makes it possible to see what is being spent on the environment as a distinct output of the economy.⁴⁶

The *Experimental System of Ecosystem Service Accounts* (ESEA) completes the measurement framework. 'Ecosystem services' is a concept that links the functioning of various ecosystems to economic values, by identifying the services that ecosystems provide to people. The standard definition of ecosystem services divides the various services into three groups: provisioning, regulating, and cultural.³⁷ In the context of the current discussion, the most important ecosystem services are in the provisioning and regulating categories. Provisioning services derive from the ecosystem characteristics that provide nutrition and supporting conditions for commercial fisheries and other living resources. Regulating services mediate flows in the ecosystem, for example, by providing flood protection.

The addition of environmental and ecosystem services accounting has a double benefit. It expands the economic information available by requiring that high quality information about the physical conditions of the oceans, and associated ecosystems, be developed at the same time. This is a complex process and the creation of fully specified environmental/ecosystem accounts can be an arduous process. But, by developing physical measurements at the same time as better economic measurements, it is possible to quickly access useful information, even if it is not fully integrated. This is the approach being taken in a number of countries.^{47,48}

Adaptive Management

The concept of adaptive management is a descendent of the idea of 'scientific management', which dominates most ways of thinking about how organisations should be run. The basic idea is simple: 'Adaptive management seeks to better achieve desired outcomes and impacts through the systematic, iterative and planned use of emergent knowledge and learning throughout the program lifecycle. It involves reacting and responding quickly to changes in the political and socio-economic operating environment'.⁴⁹ The key word in this definition is 'quickly'. Feedback, or 'performance measures' must be readily available, and changes must be detected. Organisations must be able to quickly assimilate information and make changes in policies, programmes, funding or other actions as quickly as possible.

Adaptive management in this context means that fishery managers and the fishing industry will have to respond to changes in species distribution and composition. Sustainable catch levels will need re-definition (both up and down) across different geographies. Coastal communities will need adaptation plans for sea level rise, which will generally consist of some combination of barriers (sea walls or natural systems like mangroves), structural changes to buildings (elevation or other flood-proofing), and retreat from flood prone areas. All of these actions will be taken at some point at various locations, but it is not always clear which should be taken at one specific location, and in what order. The very uncertainty about specific impacts makes every response to climate change a risky decision.

One could say that the key to an adaptive Blue Economy strategy that adequately addresses climate change is management that simulates playing chess – like moves with an awareness of possible responses and counter-moves that are three, or even four, moves ahead. This requires management that sees ahead, not only to the first decision to be taken, but also to the various options for decisions that lie ahead if circumstances change. The direction of climate change, its pace and effects, will become more and more apparent with time, so improved information will be available in the future, though it will never be perfect (or even satisfactory).

Awareness of what can be done through a sequence of decisions provides the opportunity to put action plans in place that can be quickly implemented, rather than going through the decision process from the beginning every time a relevant change occurs. A shift in fisheries management that accommodates a change in species abundance should include the steps to be taken if the trend in abundance continues or reverses. The fishing industry may make a shift in gear or location, but should also be prepared to make further shifts, including transitioning out of the fishery. Coastal communities may prepare barriers to prevent flooding, but if the sea level rises significantly, most barriers will eventually prove insufficient, and other flood proofing, or retreat, may be needed. Retreat itself is not simple - there

may be no real place to go, as is the case with small islands. Sea level rise and climate change will redefine flood plains, often over large areas. Simply moving out of the currently known flood plain is likely to be inadequate.

This type of management challenges organisations in all countries. Advanced industrial countries are also just beginning to learn how to create climate ready Blue Economy strategies. Less developed countries may have some advantages as they reshape their institutions to address the Blue Economy, since they will do so with much greater awareness of climate change. This management style will also challenge international development institutions, which are expected to provide resources and guidance on Blue Economy-related projects.

Cooperation

Nations are focusing on Blue Economy development strategies that will result in increased competitive advantage for their ocean-related industries, with a concomitant increase in output and income for national and regional economies. But climate change is an issue that all countries in the Indian Ocean region must face. Shifts in ocean temperatures and chemistry, and sea level rise, may vary somewhat across the region, but all will have to confront it. While responses to climate change must be adopted locally, monitoring of the oceans, economic changes and the processes for shaping adaptive strategies has to be done with a high degree of cooperation across the region.

This is true everywhere to some extent, but the lower and middle-income countries of the Indian Ocean region cannot be effective without extensive cooperation across borders. The region benefits from organisations such as the Global Ocean Observing System for the Indian Ocean (IOGOOS) and the Indian Ocean Rim Association (IORA), which provide the infrastructure around which co-operative approaches to information gathering and use, mitigation, and adaptation, can be organised. But all of this is still in its infancy, relative to the magnitude of the task.

The Indian Ocean region is characterised by low to very low levels of resilience. Resilience is defined as the ability of a system (natural or socio-economic) to absorb a shock and recover on its own. Nations in the Indian Ocean region have low levels of resilience for a number of reasons. Firstly, the expense of building resilience is difficult for low income countries. Next, the Indian Ocean region's geography, and urban centres, have always presented a high risk of flooding, even before climate change and its effects on weather and sea levels. This is especially true for developing, small island states such as the Maldives and the Seychelles, where the worst-case scenarios for sea level rise present existential threats. Finally, resilience is also reduced in small, highly local economies, where disruptions to just one or two industries, such as fisheries or tourism, can wipe out the economy for extended periods.

But low resilience is not no resilience. The region regularly endures disruptions of the type that will increase with climate change in both frequency and severity. The region may recover, albeit with losses higher than they need be, and over longer time-frames than is necessary. Awareness of climate change actually presents opportunities to develop the Blue Economy in order to increase resilience. Awareness of how the Blue Economy is being shaped by climate change can increase the importance of the Blue Economy in the economies of all nations in the Indian Ocean region, and do much to ensure that the Blue Economy's goal, of economic growth matched with environmental sustainability, is reached.

Conclusions

This cursory exploration of the range of possible interactions between climate change and the Blue Economy is severely limited, but it does serve to point out several major themes that inform the choices confronting the nations in the Indian Ocean – and, indeed, all nations. These may be summarised as follows:

1. The dominant effect of climate change is a disruption of oceans and coasts through changes in ocean temperature, chemistry and sea level. Most of these changes will be harmful, although some may be positive for a time. While the overall direction of climate change is known, its pace and precise threats are not knowable with precision.
2. Response to climate change must be a process that is continually being adjusted to new information. The complex interactions between climate, natural systems and economic systems must be measured by expanding the concept of the economy (and its statistics) to include environmental information.
3. Climate change is not in the future. Decisions made today will affect the economy years, and decades, into the future, and must be adaptive to the changes that can be reasonably anticipated. But adaptation is a decades-long process, and each decision must include awareness and preparation of the next steps to be taken.
4. The Indian Ocean region is characterised by low resilience with respect to climate change. Building resilience in the Blue Economy will be a challenge but is possible. While Blue Economy development seeks to advance national economies on a competitive basis, the response to climate change will require much greater cooperation across the region, to reflect both the common challenges and to reduce the disadvantages of meagre organisational and financial resources.

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Marine and Bio-resources in the Indian Ocean Rim Association

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Introduction

In a world of increasing shortages, scarcity and sky-rocketing prices, it is imperative to place the Blue Economy in the context of sustainable exploitation of available resources. The debate about sustainability is not new, although introduction of the sustainable-development concept into the development lexicon in 1987 by the World Commission on Environment and Development (WCED) took the debate to a higher level. This debate is often dominated by questions about how available resources should be exploited and whether or not existing practices allow for all to participate and benefit from their exploitation.

The exploitation of resources – in a manner that ensures their existence is sustained from one generation to another – is an important consideration for new avenues of development, such as the Blue Economy paradigm. The ocean and marine ecosystems occupy a special place for humanity. In the words of the renowned marine biologist, Sylvia Earle, the oceans are the blue heart of the planet.¹ In their recently adopted Sustainable Development Goals (SDGs), the United Nations (UN) acknowledged the role of marine protected areas in contributing to poverty reduction by increasing people's income and improving health.² SDG 14 is therefore aptly devoted to 'life below water'.³ According to the UN, oceans fulfil three crucial functions: providing key resources such as food, medicine and biofuels; facilitating the breakdown and removal of waste and pollution; and serving as a buffer against storm damage.⁴

Quantification of the foregoing contributions has become more widespread in recent times and several agencies have weighed in. Background reports for SDG 14 provide interesting statistics on what the oceans generate, their potential to contribute, and what could be lost through poor management of marine exploitation.

The high seas make up an estimated 50 per cent of the planet.⁵ Averaging a depth of 4 000 metres, the high seas account for up to 90 per cent of the habitat for life on Earth.⁶ This immensity reflects an economic value of monumental proportion. A report by the World Wildlife Fund (WWF) estimates the economic value of the earth's marine environment at US\$24 trillion.⁷ The oceans and their associated marine and coastal ecosystems generate as much as US\$2.5 trillion annually. In terms of gross domestic product (GDP), this means that the oceans constitute the seventh largest economy in the world.⁸ Their importance can be viewed from various perspectives. These include: the significant and tangible output of oceanic fishing and aquaculture; services such as tourism and education; trade and transportation through coastal and oceanic shipping; and environmental benefits such as carbon sequestration and biotechnology.⁹ Significantly, the WWF did not take the importance of offshore oil and gas production and wind energy into account when producing the estimates. Nor did the WWF factor in the oceans' influence on climate change, temperature regulation, and the spiritual and cultural benefits that they provide. The UN has paid more attention to those factors. It estimates that lost economic benefits, poor ocean management, and inadequate climate-change mitigation measures cost hundreds of billions of US dollars annually.

No comprehensive assessment of pollution in the open ocean existed until the twenty-first century.¹⁰ We now have sufficient information to summarise global pollution in the open ocean. The highest concentrations of heavy metals – mercury, lead, cadmium, arsenic, nickel and copper¹¹ – are generally close to shore of industrialised and densely populated areas. Concentrations of metals in the open ocean are low and not of toxic relevance, except for mercury, higher concentrations of which have been measured in some fish species.¹²

A CNN documentary aired in 2016 exposed the extent to which the ocean paradise has been turned into a graveyard for plastics.¹³ An estimated five trillion pieces of plastic litter the oceans. By 2050, there will be more plastic in the sea than fish (by weight).^{14, 15, 16}

It is inevitable, therefore, that governance of resources and their associated relationships assume particular importance. Governance, leadership and optimising the potential benefits of oceans are central to statistics released by the numerous agencies and governments working on oceanic ecosystems. In June 2017, the UN hosted an Ocean Conference in New York to discuss current information on marine management and mediation of relationships with marine ecosystems.¹⁷ The organisers saw their conference as an opportunity to: take stock of resources and the action needed to implement SDG 14; and to identify partners to bring about positive change, not least a reversal of declining ocean health, depleted fish stocks, and plastic pollution.

This chapter explores the importance of the marine ecosystem and bio-resources for the integration of oceans into the mainstream economies of Indian Ocean Rim Association (IORA) member countries. Importantly, it addresses the need to strike a balance between development linked to the Blue Economy and sustainable use of marine bio-resources, which includes conservation of marine biodiversity, sustainable fishing, eco-tourism and the protection of ocean ecosystems from pollution in future. Particular attention is paid to the human impact on bio-resources, the related question of sea ethics, and how the utilisation of marine resources can be regulated for the benefit of all stakeholders. Finally, the chapter examines the impact of climate change on bio-resources within IORA.

Definition and concept of marine bio-resources

While marine bio-resources have been studied for a long time, new concerns over declining ocean health and the need for better ocean management call for a novel approach. Having been more commonly studied within the discipline of marine biology, even by no less a person than Aristotle,¹⁸ the increasing developmental role of marine bio-resources constitutes a significant departure for the discipline. When the *Historia Fucorum* was published on marine algae, Samuel Gottlieb Gmelin (1744–1774) embarked on a mission to explain the new binomial nomenclature of Linnaeus.¹⁹ For the next two to three hundred years, scientists paid more attention to discovering new species of organisms and life under the seas. They applied burgeoning technology to deep-sea diving, the use of submersibles, and remote sensing. What emerged was a more elaborate mapping of the oceans, which enhanced knowledge about the richness of its holdings.²⁰

But the transition to the view that biological resources represent livelihoods is more recent. The depletion and unregulated exploitation of resources constrained development on a scale hitherto unknown, which served to focus attention on sustainability.²¹ Conservation biology emerged as a combination of biology, economics and politics; however, much of the initial work in the conservation-biology field focused on ‘terrestrial problems and issues’.²² Marine life and how it was impacted by human activity was neglected. This changed in the twenty-first century, as mankind became aware that as much as 70 per cent of the planet’s surface and 95 per cent of its life-supporting volume are accounted for by its oceans.²³ It also became clear that the conservation and sustainability challenges relating to the marine environment differed from those in the terrestrial environment.

Marine bio-resources are commonly defined as living things that reside in the oceans or surrounding ecosystems.²⁴ But in reality, in the context of sustainable livelihoods, marine resources include both living and non-living things. The

living organisms include macro-algae, micro-algae and fish, many of which are used by humans as food sources. The non-living things offer an abundant source of bioactive compounds and biomaterials. They also count as bio-resources and are important in a wide range of applications, such as agri-food, pharmaceuticals, nutraceuticals, polymer and biotechnological applications.²⁵ Current thinking stresses the importance of these marine bio-resources as a source of income and enhanced livelihood, which are worthy of sustainable exploitation and valorisation.

Human impact on bio-resources

Humans need the ocean for food, jobs, transportation and recreation. One in six jobs in the United States is associated with the ocean.²⁶ As human populations and their economic activity increased and became more sophisticated their impact on the oceans intensified.²⁷ Some human actions are helpful and promote the health of oceans and their sustainable production of the relevant bio-resources. Unfortunately, other human activity is deleterious to the welfare of the oceans and can threaten their very existence. Our awareness of the long-term effects of human activity on marine life is relatively recent and largely incomplete.²⁸ Three aspects are briefly examined here: harvesting of sea foods, the impact of our land-based activities, and the introduction of marine pests.

1. Harvesting of sea foods

Searching for food is a key human activity in relation to marine resources. Much of this occurs in the form of fishing, which has increased significantly in recent years.²⁹ While the global capture of fisheries and aquaculture production declined from 122 million tonnes in 1997 to 117 million tonnes in 1998,³⁰ they have grown to 142 million tonnes in 2008 and looked set to continue growing.³¹ Increased demand for protein, obviously fuelled by growing average incomes and decline in popularity of red meat, accounts for the growing interest in fish. But this has been accompanied by overfishing and a massive drop in large-fish populations, often by as much as 90 per cent from their preindustrial populations.³² This depletion has disrupted ocean food chains,³³ reducing the number of predators and causing unchecked growth in other fish populations. This trend is expected to continue and will cause significant alterations in marine ecosystems.³⁴

Technology employed by fishing companies and individuals – including dredging, trawling, blast fishing and cyanide fishing – also damages the ocean ecosystem.

The depletion of fish populations threatens the survival of sea creatures that feed on fish.

2. The impact of land-based human activity

Some land-based activities cause equally irreversible damage to the seas and oceans. Industrial effluents pollute adjacent systems. Increased run-off from land – an estimated 390 million tonnes each year – transports massive amounts of soil into the marine environment. This run-off often contains pesticides and other harmful chemicals that render the ocean environment more unsafe for the living things that reside there. Coastal tourism also harms the ocean. Coastal tourist destinations experience a large human influx to small areas over a short period. This exerts excessive pressure on all relevant systems and can lead to far-reaching changes in environmental conditions. The World Tourism Organization (UNWTO) estimates that, by 2020, a total of 346 million foreign visitors will invade Mediterranean tourist sites alone each year, up from the current level of under 300 million annually.³⁵

3. Introduction of marine pests

The introduction of marine species from other parts of the world poses a serious danger to ocean health in any particular ecosystem. For example, the migration of humans to New Zealand introduced species to the land and the sea that has led to loss of biodiversity. The source of these exotic organisms are ocean-going vessels. Many of these new organisms are pests that predate on existing plant and animal life.

Impact of climate change on bio-resources in IORA

There is now consensus on the role of the oceans in climate change.³⁶ The ocean's heat transfer, its heat capacity, and the global water cycle³⁷ can alter ecosystems and create new long-lasting conditions that constitute climate change. In turn, this fundamentally alters the habitat of bio-resources, sending the latter into decline or extinction if the environment can no longer provide the bare necessities for their existence. Changes have been noted in the isotopic and chemical composition of seawater and in atmospheric radiation transfer. This affects the quality of the oceanic atmosphere and how much life it can support.

Member countries and national Blue Economy programmes

While concerns about the sustainability of marine ecosystems and bio-resources are by no means new, they have not captured equal attention among IORA member countries, hence the urgency to integrate the marine ecosystem into the

mainstream economies of the member countries. Several IORA members have drawn up elaborate plans on how to optimise such integration. Three recent national endeavours to build the Blue Economy are examined briefly.

The twenty-one countries that make up the IORA grouping present virtually all the known development challenges currently being addressed, be they national, regional or global. The grouping includes Australia, an undisputedly first world nation, and the Federal Republic of Somalia, which is struggling to avert its failure as a state. In between these polar cases are poor but mature democracies such as India and Indonesia, and middle-income emerging market economies such as South Africa and Malaysia. Despite these contrasts, development patterns allow for the application of common approaches to the exploitation of marine resources that are relevant to the Blue Economy concept.

Australia is perhaps the most technologically advanced member state of the IORA. Sixth in the world in terms of its 25 760 km coastline, Australia lays claim to ocean resources of enormous proportions.³⁸ Its quest to tap this vast marine wealth goes back many years. Within the framework of the National Marine Science Committee (NMSC), diverse Australian stakeholders, operating through 26 organisations, formulated the National Marine Science Plan to provide the knowledge, technology and innovation cornerstones that will grow a sustainable Blue Economy.³⁹ The plan envisages cooperation across sectors and regions to derive maximum benefit from the oceans surrounding Australia. In launching its Blue Economy initiative in August 2015, note was taken of the potential to capture huge benefits in aquaculture growth, sea-bed mining (with an economic value of US\$12 billion), and off-shore wind energy.⁴⁰

India is the other IORA member country with a clear plan for engaging with the Blue Economy. With its extensive 7 551 km coastline, India ranks amongst the top 20 countries globally, with the largest exclusive economic zone (EEZ) measuring some 2.3 million square kilometres.⁴¹ Without question, this vast shoreline has an important continental dimension, particularly given the country's 14 500 km of navigable inland waterways (of which 4 503 km are national waterways, while the responsibility for the rest lies with state governments). This huge country, with nearly a quarter of the world's population, is a key IORA member and its activities are watched with keen interest. In August 2015, the first Blue Economy Dialogue was held in India to identify opportunities for adoption of that strategy and to respond to the imperatives of the UN SDGs.⁴² A subsequent study found that, apart from the prospect of a healthy ocean and positive foreign policy spin-offs, the initiative had the potential to promote social inclusion and environmental sustainability.⁴³

In 2014, the South African government began to articulate the need for judicious exploitation of the ocean economy – to help ward off gruelling unemployment

and poverty, especially among the previously disadvantaged.⁴⁴ In July 2014, Operation Phakisa was launched to promote the goals of the National Development Plan (NDP).⁴⁵ Former president Jacob Zuma said that the operation would ‘focus on unlocking the economic potential of South Africa’s oceans, which are estimated to have the potential to contribute up to R177 billion to GDP by 2033, compared to R54 billion in 2010’. Key elements of this initiative are its focus on the NDP priorities of employment creation, poverty reduction and equity, and the huge potential of the country’s ocean economy. Specific expectations were that the programme would: reduce the number of households with a monthly income below R419 per person from 39 per cent to zero per cent; and improve the Gini coefficient from 0.69 to 0.60.

South Africa’s extensive coastline stretches about 2 798 kilometres from the Kalahari Desert on the north west border with Namibia on the Atlantic Ocean coast to the Mozambican border on the Indian Ocean coast. While this coastline is only the fortieth longest in the world, it is one of the most diverse in terms of the water bodies involved, the range of climatic conditions covered, the sheer quantity of its bio-resources, and the socio-cultural differences of the areas it serves. The South African coastline combines an equally diverse range of resources and associated processes in respect of economic activities undertaken. This entails cultivation of ocean ethics and a far-reaching change of attitudes and values in line with the rapid pace at which the system itself adapts to external pressures.

Contribution of the oceans to natural resource management and economic development

From the foregoing it is clear that the oceans’ potential to contribute to economic development is indisputable and goes beyond the more obvious sectors of eco-tourism, fisheries, marine research and development (R&D) and biotechnology. They also have enormous medicinal value, in addition to being an important source of employment and job creation. In this section, the diverse role of the oceans in generating economic opportunities is more critically examined.

1. Eco-tourism potential as a pillar of the Blue Economy within IORA

In light of enhanced industrial activities that may derive for the Blue Economy, policy adjustments to protect the vulnerable environment should be the prime consideration. The IORA has created a single cohesive platform for member countries that border the Indian Ocean (Figure 16.1) to form partnerships that uphold environmental protection and promote sustainable use of bio-resources.⁴⁶

Figure 16.1: Site of the Indian Ocean Rim Association member countries

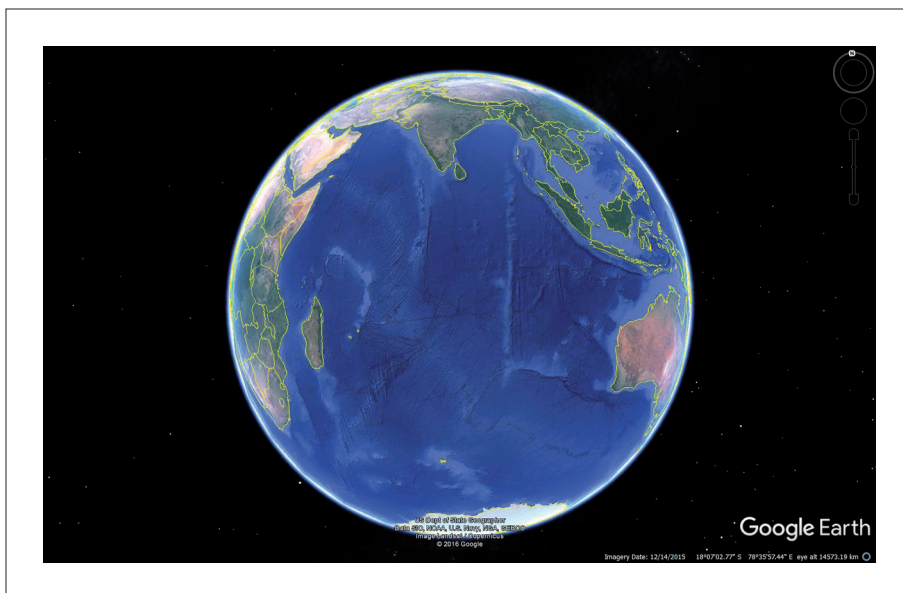


Image: Google Earth

The IORA aims to promote tourism and cultural exchange as one pillar of this sustainable use. To achieve this, there is an increasing need to quantify the unique environmental and heritage assets in the Indian Ocean region. This will facilitate the practical protection of Indian Ocean bio-resources for their potential economic and leisure value, such as for tourism and other recreational activities.⁴⁷

The region as a whole is strategically located to maximise potential partnerships within the region and beyond. Studies have revealed the inherent advantages for South Africa⁴⁸ of developing tourism and cultural exchanges that promote sustainable utilisation of bio-resources. South Africa's rich history, culture and natural resource diversity give it a competitive advantage for maximising viable ocean-based tourism.⁴⁹ However, South Africa and other IORA countries are also extremely vulnerable to the effects of climate change, including rising sea-levels, pollution and natural disasters.⁵⁰

The Blue Economy perspective aligns well with Australia's long history of supporting marine economic activity that takes advantage of its large EEZ, long coastline and number of ports.⁵¹ The natural advantages of places like the Seychelles and Mauritius have traditionally attracted hordes of tourists. An op-ed in The Guardian (UK) suggests that these traditional destinations, with their unparalleled beauty and magnificence, still do not eclipse a place like Rodrigues Island, which is marketed in tourist brochures as the last scrap of Africa before you reach

south-east Asia.⁵² Thus, in order to protect IORA's coastal and marine environments, new approaches are needed that a focus on boosting the economic potential of sustainable ocean-based ecotourism. Ecotourism may yet provide the link that reconciles heightened economic activity with a Blue Economy agenda.^{53,54}

Looking more closely at South Africa's anticipated tourism dividends, the economic value of the ocean-based ecotourism sector was estimated at R26 billion in 2009; however, the current exploitation rate is estimated at about R2 billion (less than 1 per cent of the 2009 estimate.^{55,56} The challenge here is how the country (and other countries in the region) can expand the proportion of benefits from the tourism industry that is strategically focussed on ecotourism.

It has been noted that tourists are interested in South Africa's cultural diversity, history and heritage. This unique additional offering provides the means to expand tourism in IORA and to diversify the suite of existing mainstream ocean-based activities (such as scuba-diving, shark-cage diving, surfing, coastal hiking, fishing, whale watching, and other marine wildlife watching).⁵⁷ IORA countries can grow their ocean-based ecotourism sectors through more innovative choice options for conscious travellers – who will often seek out and even pay more for pristine, untouched destinations and simplistic yet creative tourism activities (Table 16.1). Some unique and innovative ocean-based ecotourism activities that are on offer (or could potentially be on offer) in South Africa and elsewhere in other member states of the IORA are further explored. Some direct and indirect social and economic gains from these forms of ecotourism are also emphasized as a start to unpacking their potential (Table 16.1 in Appendix 1).

2. Fishery and its management within IORA member countries

Fishery is one of the important pillars of the Blue Economy. It is the harvesting of specific fishes for food security, nutrition, employment, and contribution to GDP.⁵⁸ Fishery governance and management set the amending principles, policies or maritime laws, and objectives of the sector.⁵⁹ This section presents the governance tools that apply to fisheries and management in the 21 IORA member countries.⁶⁰ It also includes a demonstration of the rich diversity of fish species found in the West Indian Ocean (WIO) shore of South Africa (Table 16.2 in Appendix 1). The records are crucial in comparing cross-country trade plans between the IORA members.

Governments have a mandate to protect and conserve ecosystems and conjure up plans for sustainable fishing practices. In ancient times, fishing was practiced freely by communities as part of their farming practice. However, corporations and law breakers saw an opportunity to make abundant income by trading fish. Soon biodiversity was being eroded. Freelance practices, such as occurred in South African waters, were also experienced in other IORA member countries.

This resulted in overfishing that disturbed the ecosystem. Governments saw that it would be fitting to create boundaries and laws in order to conserve biodiversity.⁶¹ South Africa, Australia, and India share similar policies or maritime objectives.^{62,63} A number of international and regional measures regulate fishing in the Indian Ocean, including the Indian Ocean Tuna Commission (IOTC).⁶⁴ The IOTC is an intergovernmental organisation whose mandate is to manage tuna and tuna-like species in the Indian Ocean.⁶⁵ The IOTC actively promotes cooperation among its members and relevant non-members to enhance conservation and appropriate utilisation of tuna and other fish stocks and to encourage the sustainable development of fisheries.⁶⁶

3. Marine R&D and biotechnology and medicinal values of oceans

Various marine and bio-resources, some of which are found in the IORA region, are being explored for bioactive compounds. Macro-organism examples include vertebrate animals such as fishes, frogs, snakes, and birds; invertebrate animals such as sponges, coelenterates, tunicates, echinoderms, corals, and molluscs; and algae such as bryozoans, green, and red.⁶⁷ Some micro-organisms include bacteria, fungi and cyanobacteria.⁶⁸ It is common knowledge that many marine organisms were used in traditional Chinese medicine for centuries during dynasties. In the US, the first Food and Drug Administration (FDA) approval of a drug directly from the sea only took place in 2004: the approval of ziconotide isolated from a marine cone snail paved the way for other marine-derived compounds moving through clinical trials.⁶⁹ Today, some institutes in India offer such opportunities for developing new drugs, the practice referred to as marine pharmacognosy or marine pharmacology.^{70, 71}

Marine pharmacognosy studies the chemistry of marine organisms, which are relatively unexplored in IORA and which represent a vast resource for new medicines to combat major diseases such as cancer, AIDS and malaria. Research typically focuses on sessile organisms or slow-moving animals, because of their inherent need for chemical defences.⁷² The research process through which medicinal values are extracted from marine organisms is called biotechnology. Marine pharmacology, therefore, offers scope for exploring the ocean for new drug developments of marine origin. Marine environments offer an ecological resource comprising a variety of aquatic animals, plants and fungi. These aquatic organisms are screened for antibacterial, immunomodulator, anti-fungal, anti-inflammatory, anti-cancer, anti-microbial, neuro-protective, analgesic and anti-malarial properties.⁷³

The greatest marine tropical biodiversity of animals and plants is reported from the Indo-Pacific Ocean.⁷⁴ Examples of animals (the coral reefs, cone snails, sea horses and waxy monkey frogs) and plants (seaweeds) in human medicine

form the vast biodiversity. The diversity of coral reefs can be extraordinary, with species diversity reaching 1 000 species per square metre. Many of the above-mentioned organisms in human medicine (e.g. cone snails, and sponges) live in coral reefs, the latter being threatened by climate change around the world. Cone snails, a large group of predatory snails, defend themselves and kill their prey by firing poison-coated harpoons. These toxins have provided important new compounds for medicines. One has been developed as a painkiller which is considered far more potent and safer than morphine.⁷⁵ Sea horses are harvested to treat kidney disease, circulatory ailments, and impotence with Chinese traditional medicine.⁷⁶ Some seahorse species are sold as dried specimens for traditional medicine. Live specimens are sold for aquaria culture. So there is potential for seahorse mariculture in the IORA. The technology may be borrowed from operations in China, Vietnam, and Australia, which already provide live specimens for aquaria. Amphibians also contribute to human medicine in many ways. Chemicals they contain may lead to new painkillers and drugs to treat high blood pressure. An example, though inhabitant of South America, the waxy monkey frog manufactures potent antibiotics in its skin that attack bacteria and fungi, including some that cause infections in people with weakened immune systems, such as those with HIV/AIDS.

Marine algae (seaweeds), like animals, also have medicinal, food and industrial uses. Seaweed species have recently received significant attention for their potential as natural antioxidants. Metabolites that have been extracted from marine algae have been shown to possess bioactive effects.⁷⁷ As a herbal medicine, seaweed has been used for: traditional cosmetics; treatments for coughs, asthma, haemorrhoids, boils, goitres, stomach ailments and urinary diseases; and for reducing the incidence of tumours, ulcers and headaches.⁷⁸ Extracts from a species of *Bryopsis* promise possible treatment for lung cancer, tumours and AIDS. Medicinal products from seaweed have a salty taste, which is an indication that the material can disperse phlegm that has accumulated. Iodine, a seaweed product, is used as a resolution of coronary artery disease. Seaweeds produce essence and flavour, used in the treatment of goitre, tumour, oedema, accumulation, testicular pain, and swelling. Seaweeds are also directly valuable to humans as a food and industrial raw material.^{79 80} Fresh seaweeds, both wild and cultivated, have long been used in Asian countries, in food diets alongside traditional remedies. The food industry exploits the gelling, water-retention, emulsifying and other physical properties of seaweeds. For instance, agar, a product from seaweed, is used in foods such as confectionery, meat, poultry, desserts, beverages, and moulded foods. Carrageenan is used in salad dressings, sauces, dietetic foods, and as a preservative in meat and fish products, dairy items, and baked goods.⁸¹ Essential fats and vitamins are found in seaweeds. Products of seaweed, alginates, enjoy many uses as carrageenan,

and are used in industrial products, such as paper coatings, adhesives, dyes, gels, explosives, and in processes such as paper sizing, textile printing, hydro-mulching, and drilling.^{82, 83} Seaweed is an ingredient in toothpaste, cosmetics, and the paint material used for the sheath inside the lids of coca cola bottles.⁸⁴

4. Economic investment and job creation roles of oceans

The ocean economy produces thousands of jobs and billions in investment. The South African government's ambitious project, Operation Phakisa Oceans Economy Programme (OP-OEP) with an investment budget worth 24.6 billion, is intended to unlock the country's ocean economy and to create more than 6 500 jobs.⁸⁵ OPOEP was launched by the Presidency in 2014 in a bid to find faster ways to implement the National Development Plan. Examples of areas covered in the implementation of OPOEP include: the establishment of the KwaZulu-Natal Boat-building Park, as part of the maritime vessel industrial complex in Durban; the commencement of operations at the Burgan fuel storage facility in Cape Town; and kick-starting operations at the new Sunrise Energy liquid petroleum gas facility in Saldanha Bay (Table 16.3 in Appendix 1). Investment in facilities supporting establishment of marine renewable energies (e.g. desalination plants, electricity production from renewable energy sources, sea exploration for hydrocarbons and minerals, and deep ocean water applications (DOWA)) adds to thousands of jobs created. Investment in sample collection of technological requirements, such as collecting marine samples from different sections of the ocean, and underwater collecting dedicated to marine science (aquaria facilities),⁸⁶ supports the Blue Economy and promotes awareness of the effects of climate change. Other job creating investments not yet covered include manufacturing, agro-industry, and healthcare. Intensive agro-industry, including activities such as aquaponics and hydroponics, are scarce or non-existent, as are the facilities meant for bioprospecting processes.

Vulnerabilities and threats

In spite of their enormous economic value, oceans are known to both engender and succumb to a vast amount of threats and vulnerabilities which have important policy implications. These relate as much to the overall environment as to the vast resources that are harvested from the oceans. Understanding the range of these threats and vulnerabilities is important to guide actions to optimise the contributions of the oceans.

1. Threats and vulnerabilities related to fishery

The West Indian Ocean (WIO), for instance, supports various finfish (e.g. Agulhas sole and Cape hake), shellfish (e.g. abalone and oysters), and seaweed fisheries (e.g. kelp and water lettuce) diversity.^{87,88} The South African fisheries sector faces numerous management challenges, such as resource limitations, climate change, and illegal activities (poaching).^{89,90} The current status (sustainable or unsustainable) of each fishery depends on the approach to tackle these challenges. Fish stocks are being heavily exploited, some having collapsed completely due to their demand as a source of food security.⁹¹

Climate change on its own is responsible for natural shifts in fish stocks through migration, death, high spawn numbers, and under-performance leading to diminished diversity and an eventual drop in stocks. This may lead to poverty and unemployment of people dependent on poaching for income and food. Fisheries are a highly poached industry both locally and globally.⁹² This may be due to poor law drafting for this sector and even worse implementation of existing laws and regulations. Fishery is plagued with over-exploitation of high value species (e.g. abalone) due to corruption, and poor governance and enforcement. Hence it is necessary to introduce comprehensive sectoral measures to this sector.⁹³

2. Environmental threats as an impediment to the Blue Economy

Aquatic and oceanic ecosystems are major contributors to the Blue Economy. Goods and services from these ecosystems need to be utilised in a sustainable manner to ensure long-term benefits. This requires the understanding of natural impacts and protection from anthropogenic activities that pose significant threats to the functioning of these ecosystems and the ecosystem services they provide.⁹⁴ Aquatic ecosystems in IORA member countries therefore have a huge economic potential under the Blue Economy. In fact, Blue Economy has been recognised as Africa's Future.⁹⁵

It is therefore understandable that most of the 21 IORA member countries are developing implementation plans that seek to promote the shared vision of Blue Economy, while strengthening the ecological benefit derived from aquatic and oceanic resources. Some of the sectors and/or activities that generate wealth from aquatic ecosystems of African countries include fisheries, aquaculture, tourism, transport, ports, coastal mining and energy.⁹⁶ Obtaining wealth from these natural resources confronts serious challenges and threats.

3. Threats to natural living resources

Biodiversity is high in IORA member countries and other developing tropical states, particularly in the southern hemisphere, with ecosystems such as coral reefs, mangroves, and wetlands exhibiting the highest degree of diversity.⁹⁷ Of the 21 IORA countries, five (Australia, South Africa, Indonesia, India, and Malaysia) rank among the 17 mega-diverse countries of the world. This ranking is designated to countries that exhibit great diversity, the main criterion being that a country displays endemism at the level of species, genera and families.

While knowledge of biodiversity of each IORA member state is critical for the Blue Economy, very few countries have completed assessments of their biodiversity. Within Africa, South Africa is one of the few IORA members that have assessed their biodiversity status at a country-wide scale.^{98,99} Marine species richness in South Africa is estimated to comprise 12 914 species (33 per cent are estimated to be endemics) that are distributed over 1 km² of South Africa's EEZ. Of these species, molluscs, arthropods, and fish species are the most diverse and comprise more than 68 per cent of the total biota.¹⁰⁰ Two-thirds of South Africa's EEZs fall within the Indian Ocean. Based on data from the Ocean Biogeographic Information System, the species abundance of the Indian Ocean region includes: 30 894 species of vertebrates; 4 species of Archea; 864 species of bacteria; 773 species of chromista; 75 species of fungi; 1 690 species of plantae; and 689 species of protozoa.^{101,102} These represent a fraction of the known biodiversity of IORA.¹⁰³

Within the IORA region, habitat loss, uncontrolled developmental activities in the coastal zone, over-extraction of resources, and costal pollution represent main threats to biodiversity, especially within countries where environmental regulations are weak.¹⁰⁴ In addition, pollution, climate change (e.g. sea-level rise, changes in circulation patterns and changes in sea surface temperatures), habitat modification, terrorism, overexploitation of living resources, and introduction of alien species, constitute common threats within the region (Table 16.4 in Appendix 1).

4. Threats to ocean-based ecotourism

The development of potential ecotourism activities in IORA may be hindered by a number of social, economic and environmental impacts. In particular, ecotourism is threatened by environmental impacts brought about by over-consumption of natural resources, loss of habitat due to the built environments, and changes in land use to accommodate agricultural production (Tables 16.4 and 16.5). In addition, mass tourism in already vulnerable host destination environments, piracy, war and political instability may also threaten potential ecotourism in the IOR. These impacts are often hard to detect early and make progress rapidly before they

become apparent. We discuss in summary the understanding of how to deal with some of the more common threats to ecotourism potential in the IORA (Tables 16.4 and 16.5 in Appendix 1).

Towards a set of sea ethics that will sustain the Blue Economy

As awareness grows about the potential of the oceans to contribute to diverse social and economic dividends, the question of effective management of the resources arises. As has been noted, the oceans' enormous size as a proportion of the earth's surface it occupies and the organisms it accommodates unwittingly makes them a global commons that belongs to all the people and beings inhabiting the Earth. Ironically, not all the owners of this commons can exploit it because the very nature of the high seas precludes easy access to all but those who can afford the prohibitive expense involved. This puts the high seas and oceans in a different class of commons from the land-based commons that constituted the subject-matter of Elinor Ostrom's epic work.¹⁰⁵ Apart from being excluded from taking advantage of the high seas by their own poverty, the myths, legends and mysteries that shroud these watery ecosystems constitute a formidable barrier to entry for the bulk of the real stakeholders. Again, in keeping with the rating as a commons, the oceans are considered to belong to no-one, especially once we go beyond the national waters, usually the EEZ, within about 200 nautical miles of the shoreline. And yet, beyond this point lies the bulk of the wealth that the high seas offers. Estimates of the proportion of international waters that enjoy some form of protection puts it at roughly 1 per cent.¹⁰⁶ The reason for this lack of protection for the bulk of the oceans is that national laws can only apply to national waters and become increasingly weak and ineffective beyond those areas that can be effectively policed by national authorities.

Arrangements are therefore needed to ensure that all who wish to do so can responsibly access and exploit ocean resources. Hence the call for a sea ethics. But getting to the stage where all the world's nations reach definite agreement on what needs to be done, and how it should be done, is one of the most intractable problems faced by global diplomacy. From the 1990s the UN has had in place some mechanism for dialogue among nations in the direction of protecting the vast resources held by international waters. One of the major developments under this mechanism is the drawing up of the United Nations Law of the Sea Convention (UNCLOS), which is an international treaty often referred to as 'the Constitution of the Ocean'. The purpose of this convention is to determine and delineate jurisdictions over marine areas between national and global authorities. The Convention provides guidelines for how nations access and use the world's seas and oceans

and their vast natural resources. It also contains mechanisms for addressing disputes between countries, such as the current one between the Philippines and China, discussed in more detail later in this section. As is to be expected, these talks have been long and protracted, and achievements have been modest when placed against the enormous tasks that lie ahead. For instance, several agreements have been made in relation to fishing but not much else. Many of these agreements are still at very preliminary stages and yet to be fully actioned.

As implied earlier, a set of sea ethics is not only a means of protecting the utilisation of the vast ocean resources, but also a guarantee that all who wish to profit from the seas and oceans are able to do so in a responsible manner. Getting to the stage where ocean resources can be managed in much the same way as land-based common resources are now regulated and protected is a goal worth pursuing. For instance, the Global Ocean Commission that emanated from the UN negotiations, is a very expensive system that is far from effective.¹⁰⁷ Attention has been drawn to monumental achievements of the UNCLOS, which comprises 320 articles and nine annexes and took nine years to conclude, making it the longest negotiation in UN history. For a long time, it has focused almost exclusively on organising states around extracting life from the ocean, rather than organising them to keep marine life in the sea.¹⁰⁸

Recent developments are bringing some hope. In early 2015, UN Resolution 69/292 established a two-year roadmap for drawing up a new treaty under the UNCLOS to focus on the protection of life within the oceans. Since 2016 the task teams have been at work in at least two preparatory committees held in March and August 2016 and two additional meetings in 2017. The Ocean Conference that took place in June 2017, along with the parallel Commonwealth Blue High-Level Roundtable held on the sidelines, were clearly significant developments towards attaining SDG 14 as intended. A recommendation on how oceans can be deployed for sustainable job creation and livelihood enhancement was subsequently made to the UN General Assembly with the expectation that a conference to finalise and adopt the treaty would be organised without delay.

Without question, this will be one of the most important treaties of this century, given its implication for just about any of the most serious development challenges known to mankind, notably job creation and the emerging problem of climate change. The expectation is that among the various issues it would address, the treaty would focus on the following:

- Development of area-based management tools, including a possible framework for the establishment of marine protected areas and reserves in these areas.
- Environmental impact assessments.
- Access to and fair sharing of marine genetic resources.

- Capacity building.
- The transfer of marine technology.
- Incorporation of modern environmental governance principles such as requirements for transparency and the precautionary approach.

While the foregoing represent significant progress at the global level, the real test will be in how national entities and communities are ultimately impacted by these initiatives. Some conditions that need to be met for optimum ocean governance, in the sense of governance that results in real and lasting changes for the true stakeholders of the global commons, have been documented.¹⁰⁹ Among these are:

- A sense of shared responsibility.
- Conditional access in the sense that outsiders can be invited in, but they must be subject to rules of conduct.
- Effective management and enforcement required to sustain compliance with the rules once they have been made.

Experience with some of the global conventions that the UN system has spear-headed will be instructive. Nations decide what is best for their people and, often, very little is done to secure and sustain compliance effectively. And often enough, nations may suspend their participation in global processes and can sometimes use those as basis for negotiating assistance of one type or another. As we have seen recently, the existence of the International Court of Justice has not stopped rogue regimes across the world from brutalising and marginalizing groups within their countries, and some countries have even threatened to withdraw from participation or are actually in the process of doing so. Countries with the means to over-exploit the seas can deploy their financial muscle and influence to forestall sanctions. Individuals and groups with access to technology can use those in ways that do not promote mutuality in the sharing of benefits and the rewards of protection.

In the specific case of the UNCLOS, it is quite revealing that the US has not yet ratified this convention, which was signed in 1982 and came into force in 1994.¹¹⁰ Successive Republican administrations in the White House and majority Senate Republicans in the US Congress have stood firm on their disapproval of what is seen as 'a stealth vehicle to inject euro-style precautions into US regulation'.¹¹¹ President Obama's efforts over the eight years of his presidency failed to break the stranglehold of the majority Senate and very little hope now remains with the ascendancy of Donald Trump, who has made no secret of his resentment of international agreements and environmental science. The ongoing crisis in the South China Sea dramatises the extreme difficulty presented by the continuing US refusal

to ratify the convention. The expectation in mid-2016 was that China would ignore the ruling of the International Tribunal that sat at The Hague to adjudicate on the territorial dispute between the Philippines and China over a piece of land (the Nanshan Island that measures about 0.05 square kilometres). The complaint brought by the Philippines was based on the UNCLOS Treaty, which both countries ratified. But with China alleging bias in the expected ruling and threatening not to respect it, a US intervention would have been normal.¹¹²

What this means is that action must be taken at the same time and at various levels, in order to deal with the multifarious governance challenges associated with oceans. Focusing on the use of oceanic resources is not enough, because there are multiple mediating and influencing factors that must be taken into account in formulating strategies for effective management of these resources. The extent to which the structure of IORA and its organisational profile make it possible for mechanisms to be developed for the protection of ocean resources should be examined in rounding up discussion on this matter. The relevant questions should be:

- What mechanisms are in place or can be developed to monitor the movements in the high seas of the region?
- Are there technologies that allow for species to be tagged and tracked and for those who go in and out of the waters to be tracked effectively to ensure that everybody plays by the rules?
- Does the region have access to the technologies that will allow for effective monitoring?
- How flexible are the legal arrangements within each member country to allow for new laws to be created to mandate those with the means to venture onto the high seas to do so responsibly?

Concluding remarks

While biology has been studied systematically over a very long time, possibly since medieval times, much of its early history has been dominated by its science, rather than its developmental role. The realisation that the marine ecosystem is an important element of food systems and broader economic development has contributed to the inclusion of marine and bio resources into national accounting of natural assets that have economic value. In doing so, the human impact on their availability become important issues for systematic assessments which have yielded insights into the key drivers about which policies can be crafted. For instance, it is now known that activities related to the harvesting of food from oceans, land-based activities that impact on sea life and conditions, and introduction of marine pests

are key drivers of any changes in the stock of bio-resources. A key requirement for the optimal management of this unique but fragile ecosystem is the development of environmentally sensitive techniques for exploiting ocean resources. This shall entail the cultivation of ocean ethics that are accompanied by a fundamental and far-reaching change of attitudes and values in line with the rapid pace at which the system itself adapts to external pressures. For such a change to occur, a good understanding of current practices and the mindset regarding marine systems should be developed, just as it is imperative to gain familiarity with the ecological processes that sustain marine resources, their ability to recover, and the resilience of the ocean ecosystem. What this implies for current and prospective national and international policies on marine and bio-resources is a systemic approach to safeguard their future availability.

Without question, considerable potential exists for the development of these approaches that will foster new partnerships and collaborations among countries and regions to accommodate the competing interests in marine and bio-resources, including developing measures to contain or mitigate uses of marine environment for unacceptable practices such as trafficking, terrorism and piracy. Thinking of anthropogenic influence on the world's natural resources that are exploited for human development and other economic benefits, the questions of global warming and climate change become central.

Table 16.1: A summary of unique and innovative potential ecotourism activities in four IORA countries

Country	Current and Potential Ecotourism Activities	Economic and Social Benefits
South Africa, Tanzania, Kenya Malaysia and Australia	Diversity of scuba diving ecotourism options, such as: Traditional SCUBA diving in Sodwana Bay, KwaZulu-Natal. Coelacanth eco-filming SCUBA diving in iSimangaliso Wetland Park World Heritage Site – the only area in the world where the rare fish species (featured in the National Geographic’s “Dinofish” documentary) (60), can be spotted at depths of less than 200m, which is easily accessible without the use of expensive deep-sea diving equipment (61). Potential value-chain or ripple effects from the afore-mentioned coastal-based ecotourism: The manufacturing of SUBMERCIBLES, such as Lago in the region, the building of ships (or shuttles) for marine transportation. Currently, submersibles only come from countries outside of IORA, namely the US and Germany. Shark-cage diving, surfing, coastal hiking, fishing, and whale, bird- and other marine wildlife-watching (62).	■ In excess of 80 000 divers visit the area’s coral reefs each year, which brings in foreign currency (63). ■ South Africa is marketed as an affordable ecotourism destination that grants access to a wide variety of SCUBA diving options, giving the country a competitive advantage for economic gains. ■ Coelacanth research through the African Coelacanth Ecology Program (ACEP), attracts or has potential to attract forex revenue from other IORA countries (Tanzania, Kenya, Malaysia and beyond) also claiming ownership of the ancient fish. ■ Potential job creation and growth in economy would occur through a boost in exports and imports; air travel and accommodation would be at standard international rates. ■ South Africa and Australia have some of the world’s most beautiful, revenue-making coastlines, regarding surfing, hiking and wild-life watching. Durban Beach (surfing), Cape point (hiking), and Harmanus (whale-watching) are some marine ecotourism sites found in South Africa.
India and South Africa	Indigenous village emersion experience in Kerala: Alternative for tourists seeking remote, sparsely inhabited rural landscapes of sandy beaches and lush virgin forests in Kerala, over the rest of India’s populous cities.	■ Rural community-based ecotourism activities empower the locals with small microenterprises, through diversifying their often insecure income sources (due to fluctuating prices and extreme threats of climate change on small islands).

Country	Current and Potential Ecotourism Activities	Economic and Social Benefits
India and South Africa (cont.)	'Village experience' cultural tourism: visiting a small group of islands for a few days, to spend time with the locals, and gain first-hand experience of: traditional net or bow-and-arrow fishing; climbing and picking coconuts from trees along the island coast; and river rafting to nearby villages. International memorable sites in South Africa: Table Mountain and Robben Island in Cape Town and the Cradle of Mankind in Tshwane have been declared UNESCO unique heritage monuments. The first black president of South Africa, Dr Nelson H Mandela, was imprisoned for 27 years on Robben Island by the previous regime, while the oldest human skull was excavated at the Cradle. The "village experience" cultural tourism involving visits to rural homes in KwaZulu-Natal, to spend time with locals, and gaining first-hand experience in traditional bead weaving and pottery; joining the reed dance ceremonies; and enjoying oral stories about King Shaka Zulu.	■ Rural community-based ecotourism has the benefit of increasing biodiversity conservation through decreasing exploitation of the local community's resources. ■ Cultural ecotourism provides an economically viable platform for local communities to preserve their heritage and cultural practices. ■ Locals are discouraged from migrating to urban areas as eco-friendly infrastructure is developed in rural areas to meet future demand. ■ South Africa is marketed as an affordable ecotourism destination that grants access to rare world heritage sites and diverse cultures options, giving the country a competitive advantage for economic gains. ■ Zulu culture and tradition music and dance are marketed internationally as material, drama, poem, photo and film for economic gains, bringing foreign currency to the local market and generating employment/income for local communities (61).
Seychelles, Australia, Indonesia, Kenya, South Africa, Malaysia and Australia	Conservation ecotourism and eco-voluntourism in the Seychelles: The Seychelles is an ecotourism hub that has set the example of an enabling environment for other island states, through a national tourism policy that often prohibits or restricts high-value mass tourism, whilst promoting low-impact visits that emphasises environmental protection. International impact conservation and community development ecotourism, through programmes such as the Global Vision International (GVI; http://www.gvi.co.uk/about-us/). GVI organises seasonal eco-conservation voluntourism trips on the isolated Cousin Island, where volunteers assist with conservation efforts through, for example, helping scientists and rangers collect data on giant tortoises and nesting sea turtles (65).	■ The Seychelles' national tourism policy and enabling environment continues to protect the islands' biodiversity hotspots, including well-known endemic marine species such as the Giant tortoise and sea turtles and other species protected by law in the islands' 14 MPAs (67, 68). ■ Tourists are attracted to the destination in all seasons due to the high standards of uniquely pristine and low-impact travel experience that appeals to the growing number of conscious travellers. ■ Conservation ecotourism and eco-voluntourism have become increasingly popular and have the potential to grow even more through the Seychelles ecotourism hub and enabling environment status that allows smaller local organisations to mimic the GVI's excursions to Cousin Island.

Country	Current and Potential Ecotourism Activities	Economic and Social Benefits
Eco-voluntourism on Cousin Island offers a uniquely Seychelles experience – having little cell phone reception, volunteers are forced to immerse themselves in simplistic living without the luxuries of everyday life such as flushing toilets, television, and motor vehicles (65). Similar programmes run in Australia and the Indonesian Islands. IORA countries such as South Africa, Kenya, Malaysia and Australia demarcate marine protected areas (MPAs) for purposes of ocean governance. These ideas work in a similar way to the terrestrial game reserves and wilderness, with the hope of increasing habitable population size, in order to support ornamental viewing as tourism, job creation, and community upliftment through preservation of history and biodiversity (66). For instance, coral reefs survive at higher percentage within MPAs zones than outside zones; coral reefs support diverse fish species. Seychelles, Australia, Indonesia, Kenya, South Africa, Malaysia and Australia (cont.)	■ Volunteers are able to learn about the local culture and to indulge in rare island activities bringing foreign currency to the local market and generating employment/income for local communities. ■ Growing the potential of eco-voluntourism activities also ensures that profits are directed towards local community development as a means for the de-commodification of mass volunteer tourism. ■ Eco-voluntourism is maintained in its truest form, one that upholds the ethics of conservation and promotes environmentally sensitive behaviour (69). ■ Coastal-based MPAs in Kenya scoop foreign exchange by photography and filming using glass-bottom boats, bringing foreign currency to the local market and generating employment/income for local communities.	■ Tourists are able to meet and build relationships with locals while travelling, by visiting and helping restore beautiful beaches around the world. ■ This example of a creative ecotourism activity is unique in having minimal impact on local environments and communities (62). ■ Ocean clean-up ecotourism could have a significant compounded positive effect on the environment for years to come. For example, by rapidly increasing the contribution of ecotourism to the Blue Economy as a whole, increased restoration of marine species abundance would ultimately progress towards restored marine ecosystems (71, 29, 31).
All IORA countries (with existing efforts in South Africa, Australia and the Philippines)	Beach Clean-up ecotourism: Global organisations such as Shoreline Clean-up and the Ocean Conservancy's International Coastal Clean-up, aim to promote education about the global beach litter crisis and to encourage people to volunteer in clean-up drives throughout the year (70). There is potential for attracting tourist volunteers with an interest in the problem of litter in our oceans and beaches to sign up and join clean-up drives that coincide with their visit to specific coastal areas.	

Table 16.2: Marine Fisheries Representatives found along the West Indian Ocean (WIO) Coastline of South Africa

Fish species	Scientific Name	Status	Reason for Status	Main ports in priority
Abalone	<i>Haliotis midae</i>	Unsustainable	Stock declining due to continuous poaching	Hermanus, Plettenberg Bay, Port Elizabeth, East London, Durban, Richards Bay
Agulhas sole	<i>Aurolosus pectoralis</i>	Unsustainable	High fishing effort and environmental variability	Mossel Bay, Plettenberg Bay, Port Elizabeth
Albacore Tuna	<i>Thunnus alalunga</i>	Unknown	Paucity of reliable data availability	-
Anchovy		Sustainable	The increase in TAC shows that there was no over-fishing.	Gansbaai, Hout Bay, Saldanha, St Helena Bay
Bigeye Tuna	<i>Thunnus obesus</i>	Unsustainable	The catch is very low for a large pelagic species, meaning there is a small stock.	Cape Town, Durban, Port Elizabeth, Richards Bay
Black Mussels	<i>Choromytilus meridionalis</i>	-	-	-
Cape Hake	<i>Merluccius capensis</i>	Unsustainable	This means the stock was in danger of depletion - hence the decrease.	Cape Town, Gansbaai, Mossel Bay, Port Elizabeth, Saldanha
Cape Horse Mackerel	<i>Trachurus capensis</i>	Unsustainable	There was a cautionary TAC set, indicating the species is in danger	Cape Town, Port Elizabeth
Cape Snoek	<i>Thysites atun</i>	Sustainable	Not a lot taken in terms of catch meaning that a fairly large stock still remains	All ports, harbours and beaches around the coast
Dageraad	<i>Chrysolephus cristiceps</i>	-	-	-
Dusky Kob	<i>Argyrosomus japonicus</i>	Unsustainable	-	-
Geelbek	<i>Atractoscion aequidens</i>	-	-	-
Harder mullet	<i>Chelon richardsonii</i>	-	-	St Helena Bay, False Bay, Cape Town
Kelp	<i>Macrocystis angustifolia</i>	Sustainable	There is room for further harvesting	Hermanus, Port Elizabeth, Durban

Fish species	Scientific Name	Status	Reason for Status	Main ports in priority
Oysters	<i>Crassostrea gigas</i>	Sustainable	However, poaching is a problem.	Hermanus, Knysna, Port Elizabeth
Patagonian toothfish	<i>Dissostichus eleginoides</i>	Sustainable	However, uncertainty still exists regarding assessment of current status	-
Prawns	-	Sustainable	Optimal in the deep but unsustainable in the shallow, due to drought	-
Queen mackerel	<i>Scomberomorus cavalla</i>	Sustainable	Recovery as a result of success in recruitment over the past few years	-
Red steenbras	<i>Petrus rupestris</i>	-	-	-
Seaweed	-	Sustainable	Under-utilised	-
Seventy-four	<i>Polystegianus undulosus</i>	-	-	-
Silver kob	<i>Argyrosomus inodorus</i>	Unsustainable	Over-fished	-
South Coast Rock Lobster	<i>Palinurus gilchristi</i>	Sustainable	This is not a large number in terms of harvest and fishing.	Cape Town, Port Elizabeth
South African Sardines	<i>Sardinops sagax</i>	Unsustainable	A few years of low recruitments	Cape Town, Gordons Bay, Durban
Southern African Anchovy	<i>Engraulis capensis</i>	-	-	-
Squid	<i>Sepioteuthis australis</i>	Unsustainable	This is due to the TAC set that is just above the minimum but alarmingly way lower than the maximum catch	Port Elizabeth, Port St. Francis
Swordfish	<i>Xiphias gladius</i>	Unsustainable	Uncertain, due to paucity of data assessment.	-
West Coast rock lobster	<i>Jasus lalandii</i>	Unsustainable	Illegal harvesting	-
Yellowfin tuna	<i>Thunnus albacares</i>	Unsustainable	The catch is very low for a large pelagic species meaning a small stock	Cape Town, Durban, Port Elizabeth, Richards Bay
Yellowtail	<i>Seriola lalandi</i>	Sustainable	Sustainability is uncertain due to paucity of data assessment	-

Source: Adapted from DAFF, 2014 (72)

Table 16.3: *Investments and Associated Job Opportunities*

No	Investment	Job opportunities
1.	Operation Phakisa Oceans Economy programme	The KwaZulu-Natal Boatbuilding Park (maritime vessel industrial complex in the Port of Durban, South Africa (about 500 jobs): ■ project to build specialized tugboats at the port ■ the production and repair of leisure and commercial boats (capacity to produce 150 boats annually). Construction of jetties and acquisition of the boat hoist at Port Elizabeth, South Africa. Burgan fuel storage facility at the Port of Cape Town: ■ cruise terminal concession (V&A Waterfront). Sunrise Energy liquid petroleum gas facility at the Port of Saldanha Bay, South Africa. Coastal and Marine Tourism Lab: ■ six tourism development nodes in KwaZulu-Natal, the Eastern Cape and the Western Cape.
2.	Marine Renewable Energies	Desalination plants: ■ in Richards Bay, KwaZulu-Natal, South Africa ■ some pop up in the Western Cape, South Africa. Electricity production from renewable energy sources: ■ offshore wind energy and ocean-wave energy ■ high potential for ocean current ■ ocean thermal energy conversion (OTEC) ■ ocean saline energy. Sea exploration for hydrocarbons and minerals: ■ have attracted oil and gas companies to prospect in the region ■ geophysical surveys. Deep ocean water applications (DOWA): ■ DOWA capitalises on the coldness and nutrient rich properties of very deep-sea water to develop a series of commercial activities that can be categorised as upstream and downstream ■ upstream relate to the extraction and sale of deep sea water as well as the production of green cooling or other energy conservation and production technologies ■ downstream activities include premium products such as high-end aquaculture and seaweed culture, cosmetics and pharmaceuticals, agrochemicals, water bottling and thalassotherapy.
3.	Ocean Knowledge Education	University Faculties of Ocean Sciences: ■ already in a few African universities (e.g. University of Cape Town (UCT), University of Fort Hare (UFH), University of KwaZulu-Natal (UKZN), University of Pretoria (UP), University of Johannesburg (UJ), Rhodes University (RU), University of Zululand (UniZul), University of Western Cape (UWC), Walter

No	Investment	Job opportunities
3.	Ocean Knowledge Education (cont)	Sisulu University (WSU), Nelson Mandela University (NMU), University of Dar Es Salaam (UniDar), Kenyatta University (KU), University of Nairobi (UoN), University of Mauritius); and research institutions and programmes (e.g. South African Institute of Aquatic Biodiversity (SAIAB), South African Environmental Observation Network (SAEON), African Coelacanth Ecosystem Programme (ACEP), Phuhlisa Programme, Oceanic Research Institute (ORI), National Centre for Biotechnology Information (NCBI), National Research Foundation (NRF), South African National Biodiversity Institute (SANBI), South African Network of Coastal and Oceanic Research (SANCOR), Western Indian Ocean Marine Science Association (WIOMSA), Kenya Marine and Fisheries Research Institute (KMFRI), Tanzania Fisheries Research Institute (TAFIRI)) ■ curriculum development ■ developing the course contents of a variety of proposed ocean-related studies ■ partnerships with international universities. College and maritime training centres throughout coastal areas: ■ already in operation in a few African nations (e.g. Eritrea, Kenya, Tanzania, Mozambique, South Africa, Mauritius, Seychelles) ■ acute shortage of trained technicians, surveillance officers and even pilots ■ encourage acquisition of locally trained vessel engineers ■ beach recreational resorts for hospitality staff, boat tour guides ■ lifeguards, skippers, security services, coastal surveillance, navy officers.
4.	Fisheries	Fishing activities: ■ artisanal fisheries ■ offshore pelagic and demersal fishery ■ fish aggregating devices. Seafood processing: ■ the fisheries and seafood processing sector ■ opportunities exist to increase trans-shipment activities at the ports for value-addition, such as cutting, filleting, caking and packaging ■ new fishing vessels can take advantage of opportunities, e.g. the healthy tuna stock in the South West Indian Ocean, as noted by the Indian Ocean Tuna Commission. Aquaculture: ■ In-lagoon and oceanic cage aquaculture and mariculture (emerged recently) ■ farming of high-value and niche products (e.g. seaweed, oyster and oyster pearl, crabs, sea-urchins and other shellfish) ■ farming of high-value ornamental fish (coral reef fishes, aquaria fishes) ■ fundamentals of nutrition in aquaculture (feeds, formulation, feeding) ■ health of captive aquatic organisms (management, infections, diseases, treatments).

No	Investment	Job opportunities
5.	Seaport-related Activities	Container trans-shipment: ■ cruise travelling ■ port services and bunkering. Infrastructure works: ■ cruise terminal and jetty ■ ship repair activities and storage tanks for bunkering.
6.	Marine Services	High value-added services economy: ■ regional platform for marine finance ■ marine ICT ■ ship registration ■ marine biotechnology. Film industry: ■ Documentary (e.g. film on 'Resistant Bacteria by NOAA OCEANS': coral reefs and sponges produce chemicals which break shields formed by resistant bacteria and fungi).
7.	Sample Collection Technological Requirement	Collecting marine samples from different depths of the ocean: ■ from near or on shores (accessible via <u>beach combing</u>, <u>wading</u> or <u>snorkelling</u>) ■ from deep water (via <u>dredging</u>) ■ <u>corers</u> (used for sediment sample) ■ <u>SCUBA diving</u> (visual observation under water) ■ <u>submersibles</u> (from abyss depths that cannot be achieved by scuba diving - collection extremely expensive with costs for a submersible, support ship, technicians and support staff) ■ Underwater laboratory dedicated to marine science (aquaria facilities).

Table 16.4: *A Summary of Common Threats to Ocean-based Ecotourism in IORA*

Ecotourism activity affected	Threat(s)	Details on threats
Coastal tourism that is dependent on scenic sea and beach views, and the rich animal and plant biodiversity	Extractive resource mining	Extractive resource mining - such as sand mining of sand winning (often done illegally) - is difficult to quantify or regulate and often leads to coastal erosion that is exasperated by the impacts of climate change, such as sea-level rise (73).
		Shipping routes carry millions of tonnes of oil and bunker fuel each year. Exposure to harsh oceanographic conditions along the coast means that IORA countries are especially vulnerable to major oil spills (73).

Ecotourism activity affected	Threat(s)	Details on threats
Coastal tourism that is dependent on scenic sea and beach views, and the rich animal and plant biodiversity (cont.)	Bycatch from longline and trawl fishing	Increased mortality rates of seabirds (albatross) and other marine organisms due to bycatch from longline and trawl fisheries resulting in biodiversity loss that threatens sea birdwatching, dolphin and shark-cage diving ecotourism (74).
	Coastal and ocean pollution	Coastal pollution from the vast amount of litter that collects in the sea, negatively affects the health of marine animals, causing disease, injury and starvation or drowning from entanglement of birds, fish and marine mammals (73). Toxicity of micro-plastics in the ocean combined with the effects of rising seas temperatures also changes ocean chemistry and threatens human health, food supply, tourism and economic activities (75, 76).
	Too frequent ecotourism activities in fragile, protected area ecosystems	A study warns that too frequent diving excursions, by inexperienced divers especially, may damage the sensitive coral reefs of the Sodwana Bay area, in KZN (63). As a world heritage site, the protection of the coral reefs and the coelacanths that live in underwater caves in the Sodwana Bay area is crucial for this new form of ecotourism to thrive, and to have minimal impact on this delicate ecosystem. Coordination and planning for ecotourism activities is key for preventing tourist behaviours that tend toward mass-tourism and disturb pristine environments.
Conservation and Protected Area Ecotourism (PAE)	Climate change, vulnerability to climate extreme and disasters, and poor adaptive ability	PAE is arguably the form of ecotourism activity that is most at risk to the impacts of climate change. It relies solely on the good state of natural biodiversity ecosystems, including healthy wildlife, landscapes and appropriate infrastructure, all of which are sensitive to climate change (77). Climate change has the potential to harm the entire system and any of its components. Further, impacts of climate change often compound existing vulnerabilities in ecotourism destination, such as island states, due to a disproportionate exposure to climatic extremes of some areas, as well as poor awareness and perceptions on climate change, poor adaptive capacity, and poor policy regulations (77).
All forms of ecotourism	Terrorism, violent crime and political instability	Ecotourism is susceptible to disturbances that cause a significant decrease in visitor numbers, such as terrorism, widely publicized violent crime and political instability instances in the host destinations (78, 79). For example, in the aftermath of the 9/11 terrorist attacks in the US in 2001, the number of visitors declined for the first time in almost ten years, mainly due to this historic event. IORA member countries with coastal-based ecotourism potentials but which have been hit by terrorism include Kenya, Malaysia, Egypt, Tanzania, and Somalia. It is likely that similar terrorist attacks on this scale in the IORA countries could impact negatively on ecotourism as well (78).

Table 16.5: A Summary of Common Threats to Ocean-based Trade in the IORA

Trade activity affected	Threat(s)	Details on threats
Animal and plant biodiversity is dependent on clean and healthy ecosystems	Heavy metals close to the shore and in the open ocean	Available information is now sufficient to summarize the global state of pollution in the open ocean with regards to the heavy metals (e.g. mercury, lead, cadmium, arsenic, nickel and copper); (6). Highest concentrations are generally closer to the shores of industrialised and densely populated areas. Concentrations of metals in the open ocean are low and not of toxic relevance except for mercury that has been measured in higher concentrations in some fish species (6). Expertise or tools in assessing heavy metal pollution is therefore crucial so that blue ocean activities (e.g. gas and oil exploration, ship building) can be assessed for their potential to degrade the quality of the environment (i.e. water, sediment and biota compartments). Such expertise is available in countries such as South Africa in a form of sediment baseline models for coastal ecosystems and water quality guidelines (e.g. 80, 81, 82) and in Australia in the form of quality guidelines (e.g. 83, 84).
	Other contaminants: the state of the Western Indian Ocean (WIO) region	Although metal concentrations are highest in coastal areas compared with the open ocean, an assessment of metal pollution of water and sediment in the WIO region indicated that pollution from metals is not of high concern compared to microbial pollution associated with wastewater discharges and suspended solids associated with agricultural activities, industrial effluents and transport activities (mainly dredging (85). These impacts have negative socio-economic impacts. For example, the microbial contamination of coastal waters increases human health risk and reduces the recreational values of the ecosystem, thus negatively affecting the tourism sector (85).
	Biological threats: the introduction of alien species	Introduction of 'invasive alien species' causes establishment of a new population and spread of new organisms outside their normal distribution. Examples of the most threatening invasive species include green crabs, zebra mussels, and water hyacinth. Introduction of alien species can happen deliberately or unintentionally, for example, by organisms 'hitch-hiking' (in containers), ships (water ballast), or soil. IORA member countries need to conduct a census of invasive alien species on their respective coasts and how these have changed (or are changing) the ecological function of their coastal ecosystems (86), as these species may eventually change the nature of services that these ecosystems provide. There are at least 85 species that have been introduced to the coastal environment of South Africa and a further 39 are regarded as cryptogenic species (87).

Trade activity affected	Threat(s)	Details on threats
Animal and plant biodiversity is dependent on clean and healthy ecosystems (cont.)	Ships introduced (e.g. by ballast water)	Some of the pollutants in the marine environment are introduced by ships. However, sewage discharge and chemical spills from ships is not a significant threat in the open ocean (6). Oil spills from shipping vessels occur occasionally in the open oceans (globally, there are <2 major oil spills per annum since 2010), with a generally low impact on the environment (88, 6, 89). Nevertheless, it is estimated that the amount of oil that entered the Indian Ocean from ship wrecks since the World War 2 ranges between 264 000 tonnes and 2.2 million tonnes and these ship wrecks are largely concentrated between the Persian Gulf and the Gulf of Oman within the IORA region (6, 90). Historical major oil spill incidents within the Indian Ocean includes incidents that involved the <i>Sea Star</i> vessel in 1972 at the Gulf of Oman (115 000 tonnes of spilled oil), a spill of 70 000 tonnes from the <i>Nova</i> vessel in 1985 at the Gulf of Iran and an oil spill of 67 000 tonnes from the <i>Katrina P</i> vessel off Maputo in 1992 (89). Oil spills have a significant environmental impact, even on the smallest of organisms, when oil reaches the shore. For example, the oil spill from the grounding of the <i>MV River Princess</i> off the coast of Goa in India had a negative impact on the microalgae, meiobenthic and macrobenthic organisms at the beach adjacent to where the grounding of the vessel occurred (91).
	Offshore oil and gas platforms	There are no offshore oil and gas platforms in the Indian Ocean. It should be noted, however, that explorations have been undertaken by the United States Geological Survey in coastal areas of South Africa, Mozambique, Madagascar, Tanzania, Seychelles and India (92, 93, 94, 95, 96, 97, 98).
	Manufacturing industry (i.e. plastics)	One type of pollutant, microplastics (size: <4.75 mm), is widely but patchily distributed in the marine environments of IORA (99). A conservative estimation suggests that there are at least 5.25 trillion pieces of plastics with a combined weight of 268 940 tonnes floating on the world's ocean surface (96). Comparatively, the Indian Ocean is the second most plastic-polluted ocean (1.30×10^{10} plastic pieces) after the North Pacific Ocean where 199×10^{10} plastic pieces float on its surface waters (96). Microplastics were the most abundant plastic pieces compared to the macro/mesoplastic. Microplastics which are transported to sea are a degradation product of larger plastic materials that are generally used for packaging and are generally discarded within a year of their manufacturing (99, 100, 101). These microplastics are distributed in five compartments of the ocean including surface waters, the water column, the sea bed, the sea shore and the ocean biota (102). Although there is a growing body of literature on microplastics (103, 99, 104, 102, 100, 105, 106), there is a general lack of information for the southern hemisphere, including the Indian Ocean (107,

Trade activity affected	Threat(s)	Details on threats
Animal and plant biodiversity is dependent on clean and healthy ecosystems (cont.)	Manufacturing industry (i.e. plastics) (cont.)	106). Available information indicates that some of the IORA member countries generate a high volume of plastic waste (i.e. India: 63 747 767 kg/day; Australia: 38 436 177 kg/day; and South Africa: 12 899 201 kg/day). However, high income countries, such as Australia, have better management of their plastic waste, whilst South Africa and India are within the top 20 countries that mismanage their plastic waste that potentially ends at sea (100). Microplastics have a deleterious impact in the environment but this is still an area of active research. Current knowledge indicates that microplastics have been recorded in more than 100 marine species that either absorbed, ventilated or directly ingested these particles (102, 107). Although very few studies have investigated the trophic transfer of microplastics, these have been recorded in bivalves, shrimp and fish species, all of which are consumed by humans (107). Therefore, human health risk and other socioeconomic impacts still need to be investigated. Economic costs of marine litter (including microplastics) have not been extensively studied, especially for the southern hemisphere whilst conservative estimates for selected economic sectors (e.g. fisheries, aquaculture, commercial shipping and coastal municipalities) in selected countries of the northern hemisphere has been summarized (108).
Sea level rise (loss of coastal property value), changes in circulation patterns ('freak' storms), ocean acidification, and changes in sea surface temperatures (loss of mangroves and coral reefs)	Climate change, vulnerability to climate extremes and disasters, and poor adaptive ability (coastal areas, ocean conservancies and marine protected areas (MPAs) suffer due to habitat modification)	Natural factors such as climate change may pose a significant threat to ecosystem function and services compared to anthropogenic factors. For example, high sea surface temperatures in 1998 resulted in 90 per cent coral reef mortality across selected areas in the Indian Ocean and it was predicted that similarly high sea surface temperatures will affect these coral reef communities every five years until 2025 (109). Details about areas that were affected by the sea surface warming of 1998 in the Indian Ocean as well as the extent of the damage are available (110). Recovery rate from an event such as the 1998 warming can be slow, ranging from 5–30 years (111, 109, 110) whilst billions of dollars would be lost in the process of reef mortality (110). Knowledge on the dynamics of the coral reef community across the Indian Ocean is crucial as not all reef communities will react the same (112). Habitat modification and overexploitation of the living resources (e.g. deforestation of mangroves and other indigenous forests) damage coastal ecosystems and allow erosion of coastal areas from high waves. The mangroves and coral reefs have the power to protect coastal areas and communities from climate change impacts (113, 77). In the Maldives, for instance, corals construct seawalls that break waters caused by storms (tsunami) and prevent damage to towns, villages, hotels and local industries that could follow reef degradation. It is therefore important to understand the biodiversity status of the ecosystem and its long-term dynamics before Blue Economy activities takes place as these activities will generally pose anthropogenic impacts to the ecosystems and may have synergistic or additive effects on function and services.

Trade activity affected	Threat(s)	Details on threats
All forms of trade	Terrorism, violent crime, political instability, piracy and trafficking (humans, drugs and arms)	Ocean-based trade is susceptible to disturbances that cause a significant decrease in the economy. Misnomers such as terrorism widely publicised violent crime and political instability instances in the host destinations decrease trade (78, 79). IORA member countries with coastal-based trade potentials but which have been hit by terrorism and some political instability include Kenya, Malaysia, Egypt, Tanzania, and Somalia (114). These terrorist attacks have increased drastically from <100 attacks per annum (from 1997–2011) to nearly 3 000 attacks per annum in 2014–2015 (114). It is likely that similar terrorist attacks on this scale in the IORA countries could impact negatively on economic activities including ecotourism (78). A comprehensive list of terrorist attacks is available from the Global Terrorism Database (115).

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Ocean Health in the Blue Economy

David O. Obura

Introduction

The Indian Ocean falls behind both the Atlantic and Pacific in terms of development and trade. Indian Ocean Rim countries are generally at earlier stages of economic development, a corollary being that both population and economic growth rates in coming decades will be higher than in Atlantic or Pacific Rim countries. As a result, ocean economy sectors in the Indian Ocean, which are covered in earlier chapters of this book, will grow rapidly in the coming decades, which increases the urgency to establish a sustainable blue economic pathway to growth.

The Blue Economy is part of an emerging global movement that is turning attention away from already-crowded terrestrial spheres to the 70 per cent of the planet that is covered by ocean. At regional and continental levels in Africa and Asia, it is being hailed as the solution to future growth.^{1,2,3,4} The ocean's potential to provide for both economic development and human welfare in the coming decades is vast, and this being increasingly recognised in Indian Ocean countries, as well as in continental^{5,6} and global⁷ circles.

The many production sectors that play a role in blue economic development (such as transport, trade, minerals, fisheries, aquaculture and energy) are covered in other chapters of this book. The focus of this chapter is on the importance of ocean health in supporting growth in wealth and income from the marine environment. There are consequences for how sectors (both those that are dependent on ocean health and those that are independent of ocean health) must be managed, which implies a need for multi-sectoral planning approaches that are sensitive to ocean health, as well as a need for finance and investment based on ocean health principles.

Indian Ocean rim and island countries are diverse, varying from some of the most populous in the world (India, Indonesia) to the least populous (the Seychelles), from developed economies (Australia) to emerging ones (India, South Africa) and

to least developed economies (the Comoros, Myanmar). There are also small islands with varied economies (the Maldives, Mauritius). Cultures are diverse, and include Asian, African, Arabian and European. The perspectives and motivations governing behaviour and the perception of sustainability in Indian Ocean rim countries are equally diverse.

What does the Blue Economy mean?

Many different definitions of 'Blue Economy' have been put forward, but of importance here is that it is currently seen as a subset (focused on sustainability) within the larger 'marine and coastal economy'.^{8,9} From an ecological perspective, 'blue' economy is equivalent to 'green' economy, in relation to the ocean and its ecosystems. This is a wider understanding than some constructs of 'blue economy', which refer more to generating economic wealth from ocean resources, with limited commitment to ecological sustainability and limits to extraction.^{10,11} Development cannot be sustainably built on excessive or forever-growing extraction, and critical issues related to ocean health that need to be addressed in building a sustainable Blue Economy for Indian Ocean rim countries will be highlighted in this chapter.

Key concepts of the Blue Economy that are relevant to this view on sustainability include: a sustainable economy 'founded on nature' and cognisant of the limitations of ecosystem processes;¹² the idea of a 'circular economy' across all levels - from micro-economics and enterprises to macro-economics and government policy decisions; technological, social, and ecological principles associated with the new agricultural revolution that is being sought for Africa;¹³ and finally, the concept of planetary boundaries that focuses on global pressures and associated drivers that have reached, or will soon exceed, limits on a planetary scale.^{14,15}

The Blue Economy as a national goal

A few countries have led the way in developing Blue Economy national development pathways.¹⁶ Malaysia and South Africa are focussing on a pathway of rapid growth towards advanced stages of national development. Mauritius' focus is on ocean jurisdiction and resources as the foundation of national economic growth, because terrestrial resources are limited; and the Seychelles and the Maldives have focussed on making ecosystem processes national assets. There are clearly various ways for a country to pursue a Blue Economy. Nevertheless, the African Union's Integrated Marine Strategy and Agenda 2063^{17,18} gives little explicit guidance on how to do it. The 'Partnerships in Environmental Management for the Seas of East

Asia' programme (PEMSEA) has published a brief guide on the concept of a Blue Economy, but it recognises that it is not yet possible to provide the kind of detailed technical guidance that will eventually be needed, especially by least developed nations.¹⁹

Whisnant and Reyes²⁰ and UNECA²¹ clearly and concisely emphasise the sustainability aspects of a Blue Economy, which

... requires an integrated, holistic and participatory approach that includes sustainable use and management of Blue Economy resources for societal progress.²²

They continue,

The new Blue Economy framework offers an integrated, systemic, dynamic, inclusive, participatory, and ecosystem-based approach in which sectoral barriers are minimized at the activity and governance level, and environmental, social, and economic dimensions are intertwined and pursued for all Blue Economy activities.²³

From an environmental and conservation perspective, the Blue Economy has been defined by a set of principles that focus on ensuring a balance between environmental, social and economic benefits, so that ecological integrity is maintained (or restored) and protected for future prosperity (Box 17.1).²⁴

Box 17.1: *Holistic Definitions of a Sustainable Blue Economy*²⁵

A Blue Economy is a marine-based economy that:

- Provides social and economic benefits for current and future generations.
- Restores, protects and maintains the values of marine ecosystems (natural capital).
- Is based on clean technologies, renewable energy, and circular material flows (circular economy principles).

A Blue Economy is governed by public and private processes that are:

- Inclusive.
- Well-informed, precautionary and adaptive.
- Accountable and transparent.
- Holistic, cross-sectoral and long- term.
- Innovative and proactive.

Four key elements for a blue economy:

- Protect, restore and sustain healthy coastal and marine ecosystem services.
- Generate sustainable, equitable economic benefit and inclusive growth.
- Integrate approaches between multiple industries and government.
- Innovate, informed by the best available science.

The importance of ocean health

Ocean economies have not generally been quantified as distinct items in national and international accounting. This obscures how important they are, and consequently hampers research into protecting and growing their value for long-term economic security.²⁶

As is the case with terrestrial resources, distinction must be made between those sectors of the ocean economy that are based on living resources, and those that are based on non-living resources. Outputs of the former are determined and limited by ecosystem functions, and are vulnerable to degradation resulting from their use and extraction. They are also vulnerable to pollution, and to direct or indirect impacts from the use and extraction of non-living resources.

This chapter makes the case for strong application of sustainability principles in developing the Blue Economy, by presenting recent estimates of the value of ocean health, and exploring case studies where: the ocean's productive assets are declining (coral reefs); output has peaked (fisheries); and emerging global threats have a serious, but currently unknown, impact on a whole range of ecological functions (ocean acidification). It also summarises the key threats to ocean health from the perspective of economic sectors that utilise the ocean, but are not dependent on it, as a basis for arguments about balancing uses and impacts of ocean assets. Some national examples of blue economy approaches are also highlighted.

Estimates of the value of ocean economies

Varied estimates of the value of ocean economies have been made (Table 17.1). It is important to note that these are only provisional estimates, which do not value all benefits derived from the oceans comprehensively. Even so, current estimates put the global ocean economy seventh in comparison to all national economies, and at a regional scale in the Western Indian Ocean it is placed fourth in relation to

regional economies. It is likely that with more comprehensive and accurate quantification, the actual values will be found to be significantly higher.

At this level of importance, and given that a large proportion of it is based on living resources that are under threat from over-use and damage from direct and indirect sources, the ocean economy is clearly in need of active management and a detailed investment perspective, in order to grow its value and output, rather than diminish this through destructive activities undertaken with short-term objectives.

Table 17.1: *Estimates of the Value of the Ocean Economy at Global and Regional Scales*^{27,28,29}

Scope	Amount and scale	Comments	Source
Global	€1.5 trillion - compared to a global economy of about €70 trillion.	Value in 2010. Total annual economic value of maritime related activities reached. It is forecast that by 2020, this figure will reach €2.5 trillion per year.	UNECA 2016
Global	US\$2.5 trillion. Ocean economy: 7 th compared to national economies globally.	Sectors dependent on living assets plus shipping/maritime trade, excluding extractives.	Hoegh-Guldberg et al., 2015
Western Indian Ocean	US\$20.8 billion. Ocean economy: 4 th of the ten national economies in the region.	Sectors dependent on living assets, excluding maritime trade and extractives.	Obura et al. 2016
Melanesia	US\$5.4 billion. Ocean economy: 3 rd of the five national economies in the region.	Sectors dependent on living assets, excluding maritime trade and extractives.	Hoegh-Guldberg et al., 2016

The annual productivity of the ocean in this table can be compared to the income obtained from fixed assets in e.g. manufacturing and banking. Thus, from asset values calculated many hundreds of billions of dollars (Figure 17.1a), annual output is realised between one and ten billion dollars (Figure 17.1b), at a productivity ratio of around five per cent. The three analyses by Boston Consulting Group in Table 17.1 classified assets and their outputs in three categories: direct outputs from the ocean (e.g. fish stocks), direct services from the ocean (e.g. tourism), and adjacent coastal assets (e.g. hotels, infrastructure etc).³⁰ While ocean asset values were greater than adjacent coastal assets, particularly for fisheries, annual productivity from coastal assets (coastal tourism and carbon sequestration in particular) and direct ocean services (mainly marine tourism), were higher than for fisheries. In terms of annual productivity, industrial fisheries were only the fourth most productive sector, with coastal tourism a clear lead (Figure 17.1b). This mirrors global

patterns, where tourism provides the highest annual value from ocean assets, as shown by Hoegh-Guldberg et al.,³¹ and through other studies (see Box 17.2).

Natural capital assets that deliver annual output can be considered analogous to major investment funds (e.g. sovereign funds)³² that deliver annual returns. From Figure 17.1 it is clear that the annual return from ocean assets is lower than that from coastline assets. The reasons for this may relate to added value (e.g. of urban and industrial/manufacturing activities) and management in built-up coastlines that enable higher rates of return to be obtained. It is likely that increased investment in the ocean economy will increase its returns, if managed well, and with a long-term asset-building mentality. We are currently in the early stages of characterising and managing ocean assets, and there is as yet no fixed typology of asset types (Table 17.2).

Figure 17.1: Value of a) Ocean and Coastal Assets, and b) Annual Production - for Western Indian Ocean Countries³³

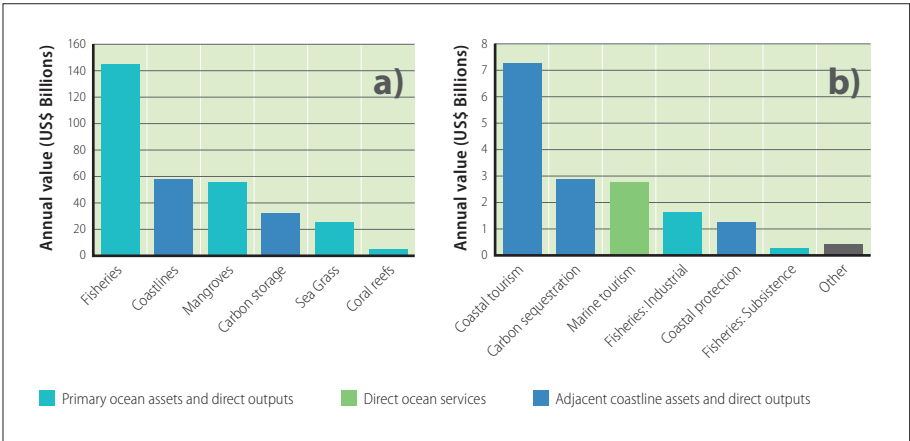


Table 17.2: Asset Categories Relevant to Ocean Economic Sectors (These may be located in the ocean or adjacent coastlines, or span both.)^{34,35}

Benefits class	Ocean >>	<< Coastline/adjacent
Living - harvest of resources	Marine fisheries, biotechnology	Agriculture, forest/other products
	Aquaculture	
Living - productive habitats	Mangroves, coral reefs, sea grass	Forests, estuaries
	Tourism, carbon storage	
	Coastal protection, water resources	

Benefits class	Ocean >>	<< Coastline/adjacent
Non-living	Shipping/transport	Coastal and urban development, infrastructure
	Minerals, hydrocarbons, Renewable energy – wind	
	Renewable energy - wave, tide	
Cultural/intangible	Cultural and religious, recreation	

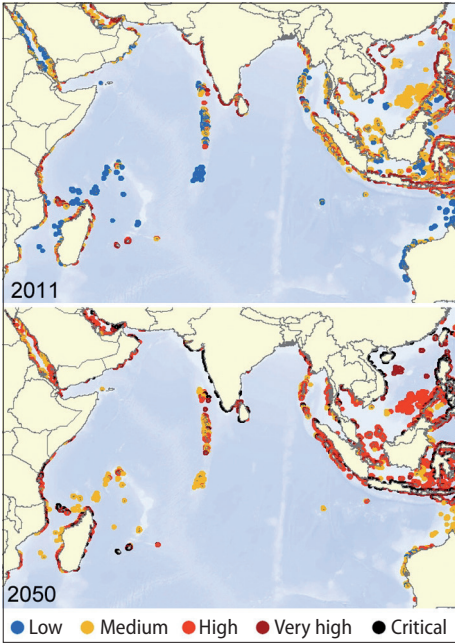
The lack of a ‘long-term fund management’ approach in managing ocean assets is illustrated in the following examples, where the primary assets and/or their output are under duress and/or in decline.

Coral reefs

In 2011, the Reefs at Risk assessment project³⁶ determined that over 65 per cent of reefs in the Indian Ocean (Figure 17.2) were at risk from local threats (coastal development; marine-based pollution and damage; over-fishing and destructive fishing; watershed-based pollution), with one-third at high or very high risk. This assessment did not include climate change-related threats, and once these were incorporated in projections, the level of risk for all reefs across the ocean basin, by 2050, rose to medium or higher, with many reef areas in East Africa, the Indian sub-continent, the Gulf and the Indonesian seas rising to critical levels.

More recent analysis of the frequency of severe coral bleaching under different future scenarios^{38,39} shows that under a business-as-

Figure 17.2: *Maps of Risk Assessed for Indian Ocean Coral Reefs for 2011 and 2050. Colour coding of risk for individual reefs is shown in the legend at low, medium, high, very high and critical levels.*³⁷



usual scenario, the least threatened reefs in the Indian Ocean (mainly in the Maldives, the Chagos Archipelago, the western Indian Ocean islands and the Red Sea) all experience severe bleaching twice per decade between 2040 and 2045 (Figure 17.3, yellow shading). At this frequency, there is insufficient time for significant ecological recovery from mass coral mortality, resulting in the collapse of the coral reef ecosystems. No reefs in the Indian Ocean are projected to survive beyond 2060 (Figure 17.3, light blue shading).

This analysis begs the critical question: With no reefs in the Indian Ocean projected to survive past about 2040-2060, apart from the biodiversity and environmental losses, what will happen to those economic and social sectors that are dependent on functioning coral reef ecosystems? The pursuit of a Blue Economy pathway requires the utmost urgency to minimise threats to coral reefs and related ecosystems. This can be achieved using a two-pronged approach:

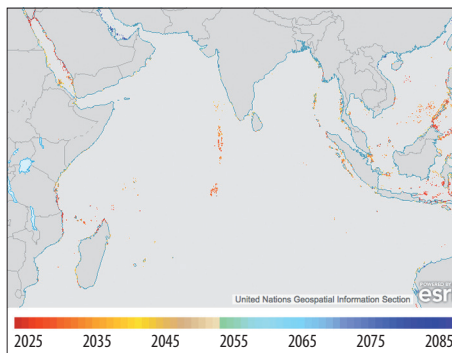
- Minimising local threats, to give coral reefs the best chance of withstanding climate-related threats; and
- Immediately embarking on action to achieve the Paris Climate Agreement and, more importantly, the 1.5°C limit.⁴¹

Without this action, an important and flagship component of Blue Economy pathways for Indian Ocean countries will have been lost.

Sustainable fisheries

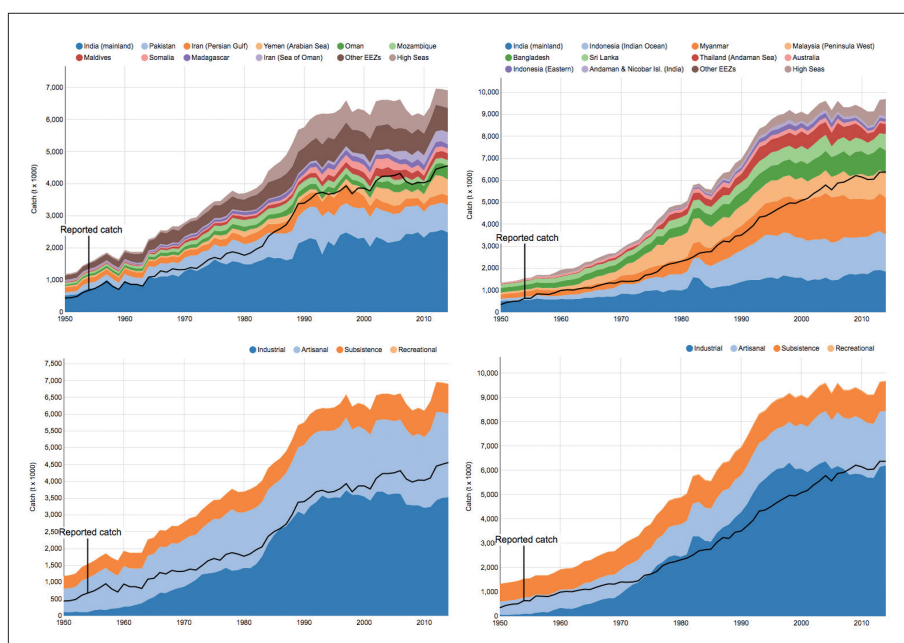
Marine fisheries are among the most valuable of ocean sectors, employing many millions of people and providing essential protein in the diet of hundreds of millions around the Indian Ocean. Catch statistics from fisheries are reported voluntarily by countries to the United Nations Food and Agriculture Organization (FAO), but many challenges dog accurate reporting, particularly for small scale fisheries where catch is landed at local levels, and may not enter into national fishery statistics.

Figure 17.3: *Bleaching Conditions Twice per Decade Under RCP 8.5. The colour coding of reefs indicates the year at which 2x per decade severe bleaching conditions are reached.⁴⁰*



Efforts to account for this are being undertaken by the Seas Around Us project,⁴² whose adjusted statistics show that total marine catch (including fish, crustacea and other groups) in both the western and eastern Indian Oceans, is estimated to have stabilised since about 1995 (Figure 17.4). Total catch in the western basin is estimated at about 7 million metric tonnes, and in the eastern basin at 10 million tonnes. In both basins the largest fisheries sector is industrial, followed by artisanal and subsistence sectors.

Figure 16.4: Total fish catch (in thousands of metric tonnes) from the western (left) and eastern Indian Ocean FAO regions, shown by the top ten countries (top, including High Seas) and by four fishery sectors (bottom).⁴³



The plateau in fisheries production since 1995 suggests a limit has been reached in the amount of biomass that is extractable from the Indian Ocean. While there are many arguments for increasing fishery output through improved techniques and management,⁴⁴ the question of what the basin-level production limit really is must be assessed carefully - at both national and regional levels. It may be possible to expand production by accessing new stocks, but without science-based management, this may only lead to over-exploitation in the future, if recent trends are a sign of future outcomes.

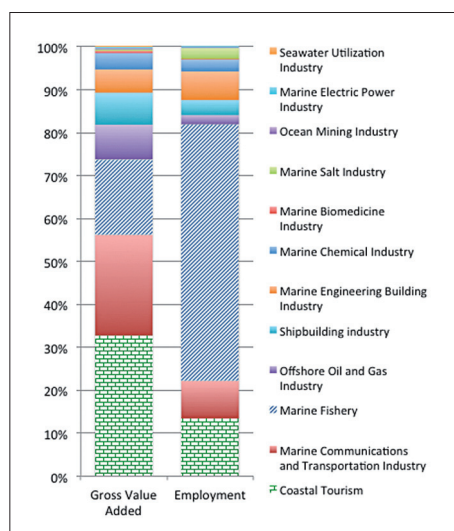
Further, the smaller catch levels of subsistence fishing belie the fact that it likely employs several times more fishers than either industrial or commercial fishing.

Small-scale fishers are highly dependent on fish for protein and nutrition, with few financial and equipment assets to access other fisheries or economic opportunities. Assuring the sustainability of this fishery sector is a key factor in alleviating hunger and poverty, and in ensuring social stability and equity in the developing countries of the Indian Ocean rim.

Box 16.2: *China – Income versus Employment in Ocean Economy Sectors.*

In China, the largest ocean sector in terms of financial value (income) is tourism (33 per cent of total value), with transport in second place and fisheries in third (23 and 18 per cent respectively). However, the picture is very different from a social and employment perspective, where reliance on ocean health affects 60 per cent of jobs dependent on the ocean, followed by tourism and transport (13 and 9 per cent respectively). Ecosystem assets produce about 50 per cent of gross value (tourism and fisheries) and 70 per cent employment. This emphasises the hidden cost of environmental degradation, which may undermine livelihoods and jobs, particularly in low-income brackets.

Figure 16.5: *Proportional Reliance on the Ocean in China, quantified by gross added value and employment. Data is from 2010, with total value of US\$ 239 billion and employment of 9.25 million people.⁴⁵*



Further, the demand for fish will be further magnified in the future by human population and economic growth; population is estimated to quadruple in Indian Ocean rim countries of East and Southern Africa, and double in rim countries of Asia, by the twenty-second century. A sustainable Blue Economy approach must critically assess the ecological and ecosystem impacts of increasing extraction of biomass from the sea, and of the compensatory growth of aquaculture that is already happening, and which will accelerate in the coming decades. What level of fisheries and aquaculture will be sustainable, and will countries in the region, and regional institutions that manage fisheries in the high seas, have the political will to manage for sustainability?

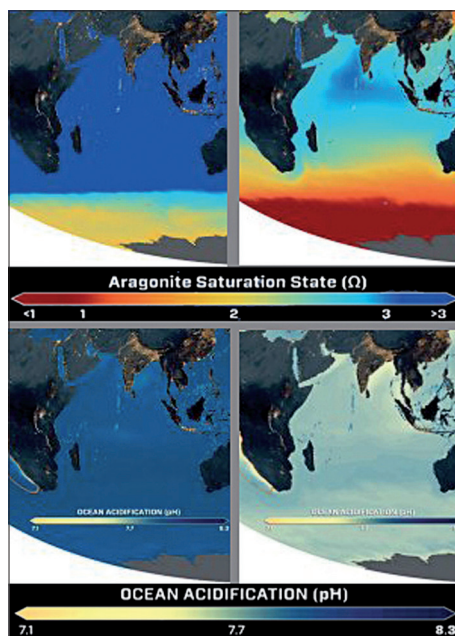
Ocean acidification (OA)

The ocean has absorbed about one-third of the carbon dioxide released by human activity since the Industrial Revolution, resulting in acidification of ocean waters (Figure 17.6).⁴⁶ In essence, this is a specific form of pollution impact on the ocean, where an end-product of the internal combustion engine used to burn fossil fuels – starting with coal and then including petroleum and natural gas – has a detrimental impact on the sea. Deeper waters are generally more acidic, and an effect of ocean acidification is to raise the aragonite saturation depth, so that it becomes shallower, which makes conditions for shallower water species less suitable.

The biological impacts of acidification are diverse and highly variable, as it alters the basic biochemistry of life in the sea, affecting microbial, planktonic, benthic and pelagic species, their development and population biology, and their interactions with one another.⁴⁸ For example, many benthic and planktonic species that have calcium carbonate skeletons (such as foraminifera and coccolithophores, which underpin planktonic food-webs and therefore pelagic fisheries) generally have lower growth rates, lower survival rates, and deformed skeletons under projected future acidification. More acidic conditions may benefit some groups of non-calcifying plankton and macroalgae. Fish are expected to be less impacted by acidification, but squid and octopus may be more vulnerable.

Because the impact pathways of ocean acidification on so many ecological processes are still uncertain, its impacts on ecosystem service provision, such as fisheries and aquaculture, and thence on livelihoods and economic activity, are hard to predict.^{49,50} In the short term, any shifts and changes in services, and how services can be exploited, will result in increased costs and difficulty for economic sectors dependent on them, particularly if shifts are sudden, such as in the case of upwelling of cold acidic waters on oyster farms, documented in the Pacific

Figure 17.6: Aragonite Saturation and pH of Indian Ocean Waters, from 1850 (left) and projected to 2100 (right) under carbon emission scenario RCP8.5 (business as usual).⁴⁷

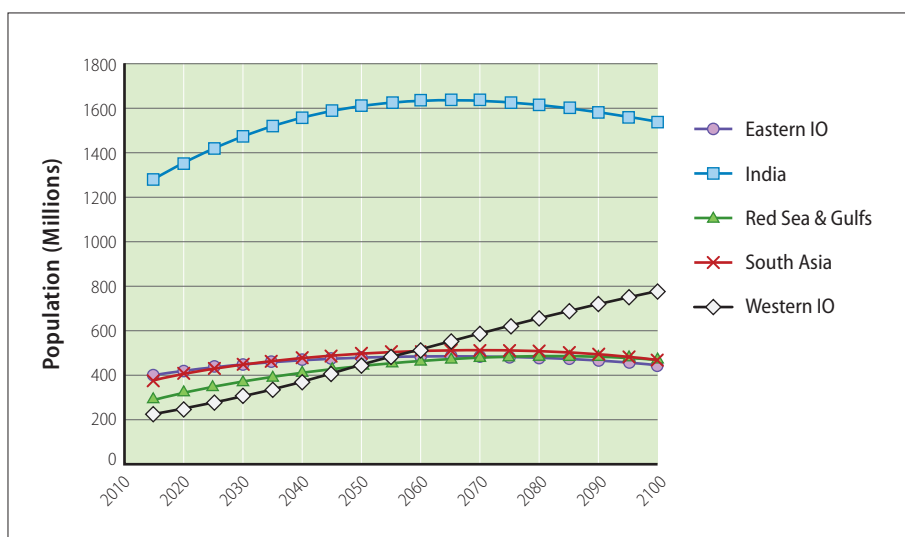


Northwest of the United States.⁵¹ With little historical monitoring or research on ocean acidification in the Indian Ocean, regional analysis and recommendations of the impacts of ocean acidification on fisheries and aquaculture are precautionary, and include implementing best practice in fishery and aquaculture management, shifting towards acidification-resilient species and breeds, and investing in blue carbon ecosystems.

Threats to ocean health

Prior chapters in this book present the various economic sectors that have potential for growth in the Indian Ocean, and care must be taken to ensure growth occurs with minimal impact on the environment. A key driver of environmental impact is human population growth, with total population in Indian Ocean rim countries set to grow from 2.6 billion in 2015 to a peak of just over 3.7 billion in 2090.⁵² India dominates throughout this period, but while its population and that of other Asian and north African populations will peak around 2060-2070 and subsequently decline, east and southern African rim populations will still be increasing (Figure 16.7). Migration within countries is also a significant feature, with growth rates in coastal areas forecast to be approximately double that of national average growth rates, as people are drawn to the assets and opportunities of the coastal zone.⁵³

Figure 16.7: Population projections for Indian Ocean Rim sub-regions⁵⁴



The Gulf seas in the northwest Indian Ocean have been the epicentre for oil and gas development for over five decades; now exploration and potential development are ramping up in the western Indian Ocean. Natural gas finds under the seabed in Mozambican territory alone exceed 140-180Tcf (trillion cubic feet) - equivalent to the gas reserves of Nigeria and with potential production levels nearing those of Qatar.⁵⁵ This sector alone has the ability to transform the economies of East African countries into energy exporters, though care must be taken to ensure a sustainable blue economic pathway is followed - one that avoids environmental impacts from excessive development.

The potential for seafloor mining of precious metals along the Central Indian Ocean Ridge and the Carlsberg Ridge is significant, with multiple claims being registered at the International Seabed Authority. Such mining activity is destructive to seabed communities, as it involves scraping the surface of the ocean floor. Viable extraction is likely not possible for several decades, due to economic and technological hurdles; nevertheless, the foundations for extraction are being put in place within the sector.⁵⁶ The development of appropriate regulations and controls to ensure minimal impact to the environment, and preservation of assets that are important for other sectors of the Blue Economy, is an urgent priority to safeguard against future damage.

Incorporating ocean health into economic and development planning

The ocean is a shared and connected space, and the Blue Economy approach builds on concepts initially developed through Integrated Coastal Management.^{57,58} In transforming marine and coastal economic activities to the Blue Economy approach, the importance of balancing these sectors and multi-stakeholder interests is paramount, and a focus on the reliance of different stakeholders on different components of ocean health and resources is essential. The following case studies, from selected Indian Ocean Rim Association (IORA) member states, emphasise this balancing act.

1. South Africa - Operation Phakisa

Operation Phakisa was initiated in 2014 by Presidential Order to unlock the economic potential of South Africa's Exclusive Economic Zone (EEZ).⁵⁹ A Sesotho word, 'phakisa' means 'hurry up', emphasising the urgency for development felt in the nation. The project borrowed from Malaysia's experience with the Big Fast Results model, bringing together over 180 stakeholders from national and

provincial government, the private sector, civil society, labour and academia, to brainstorm and identify the way forward. Four focus areas were selected as new growth areas: marine transport and manufacturing, offshore oil and gas exploration, aquaculture, and marine protection services, and ocean governance. These are to be integrated in an 'over-arching, integrated ocean governance framework for sustainable growth of the ocean economy that will maximise socio-economic benefits while ensuring adequate ocean environmental protection within the next five years'.⁶⁰

To ensure the health of the oceans and sustainable benefits from the ocean economy in the long term, a number of aspects were targeted in relation to ocean governance: accelerated capacity building; enhanced and coordinated enforcement; the establishment of an ocean and coastal information management system with earth observation capacity; oceans and coastal pollution monitoring; the creation of a marine protected area (MPA) representative network covering five per cent of the EEZ; and investment in marine spatial planning (MSP). Many aspects of Operation Phakisa are still under establishment, for example, the proposed network of MPAs, which is the cornerstone of the sustainability dimension, was circulated for public comment during 2016 and was under review through 2017.

A key component of the overall plan is the MSP component, through which well-defined management plans will enable economic sectors to co-exist and raise investor confidence in future plans. The MSP process is planned to tie in to the establishment of an Oceans Secretariat that oversees the overall operation, and will start work in parallel with the official appointment processes. For the entire five-year plan, from 2014 to 2019, a total budget of 1.72 billion (over US\$150 million) was estimated, illustrating the importance placed on the ocean as a productive asset, and the leverage the government expects this sum will generate in economic growth for the country.

2. The Seychelles

The Seychelles is blessed with varied islands, including high, wet granitic; and low, arid coralline ones, set in a vast EEZ of some 1.4 million km² rich in shallow and deep ocean ecosystems, and located at the centre of the migration of Indian Ocean tuna. With a small population of under 100 000 people, and a well-developed national culture that values and respects the sea, it is poised to make the most of ocean economy possibilities in coming decades. Tuna fishing and processing forms the primary income stream for the country. The Seychelles has developed a visionary development plan that created port and cannery facilities with off-shore partners to ensure the catch is landed and processed nationally such that value-added exports bring greater income into the national economy. In parallel

with this, the far-flung outer and granitic islands provide diverse opportunities for low-impact, high-value tourism. The Aldabra Atoll World Heritage site is the flagship for conserving, protecting and valorising natural assets of both national and global significance.

Set against this background, the Seychelles government embarked on Blue Economy planning in its 2012-2020 development plan, using a concept borrowed from global conservation assets and debt-for-nature securitisation of natural assets.⁶¹ The government, in partnership with The Nature Conservancy (TNC), negotiated a debt swap with its Paris Club creditors and South Africa, in exchange for government commitment to enhancing marine conservation and climate adaptation. This involves transferring approximately US\$80 million of national debt to the Seychelles Conservation and Climate Adaptation Trust. This was in exchange for a commitment to sustainable ocean economy planning for 30 per cent of its EEZ, of which half will be in no-take marine protected areas. An MSP process has been initiated to identify how this will be implemented. Additional mechanisms, such as blue bonds, are under consideration by the government. The MSP/debt-swap concept won the second Ocean Innovation Challenge at the February 2017 Economist Oceans Summit in Djakarta, Indonesia.

What to measure in the Blue Economy?

Fundamentally, a diversified and multi-sectoral approach to measuring wealth requires the ability to account for varied benefits generated from different blue economic assets, as well as for aspects such as social welfare, social resilience and long-term sustainability. A new system of accounting will need to be developed to facilitate growth in the Blue Economy approach, similar to what is being done in investigating ways to account for intellectual capital in technology and information corporations.^{62,63}

Initial steps in this process have been taken at national level via the natural capital approach, which focuses on identifying and accounting for natural capital assets that underpin national economies, and that are the foundation of sustainable growth.⁶⁴ Expanded use of the natural capital approach by countries of the Indian Ocean rim, extending these principles to ocean assets within national jurisdictions and in the high seas, and exploring innovative accounting principles, could facilitate a Blue Economy. Other approaches for assessing ecosystem services provision, which are being used at the UN and World Bank levels, include The Economics of Ecosystems and Biodiversity (TEEB), and Wealth Accounting and Valuation of Ecosystem Services partnership (WAVES).

Box 17.3: *Ten Sectors in which Blue Economy-related Investment Needs to Reduce and Reverse Impacts on Ocean Natural Capital Assets*

- Coastal and Offshore Transport
- Ecotourism/Sustainable Tourism
- Energy, including hydrocarbons and renewable sources
- Enterprise and Livelihood Development
- Fisheries and Food Security
- Habitat Protection, Restoration and Management
- ICM and MSP Development and Implementation
- Natural and Man-made Hazard Prevention and Management
- Pollution Reduction and Waste Management
- Water Use and Supply Management.

Source: Adapted from PEMSEA 2015

A range of other indicators that may be useful for measuring progress in Blue Economy application, and that cut across economic, social and environmental divides, are listed below. Each have their strengths and weaknesses, to be explored and improved on over time:

- Human Development Index (HDI)
- Index of Sustainable Economic Welfare (Genuine Progress Indicator, or GPI)
- Green GDP
- Genuine Savings (GS)
- Gross National Happiness (GNH)

Internalising 'Blue' into sectoral perspectives

Transformation will be needed in contemporary approaches in all economic sectors involved in the Blue Economy approach (Box 17.3). Figure 17.8 presents a schematic of the major economic sectors: they fall on two axes, i.e. dependence and impact on ocean ecosystems. Four quadrants are illustrated, and the goal is to push all sectors, whether they have high or low dependence on living marine assets, to acknowledge the finite nature of natural resources and so ensure minimal impact on any ocean assets.

Fisheries, aquaculture and tourism are key sectors with high dependence on ecosystem functioning, and all mainstream national sectors tend to be in the high-impact quadrant in Indian Ocean countries. Policies and legislation that transform them

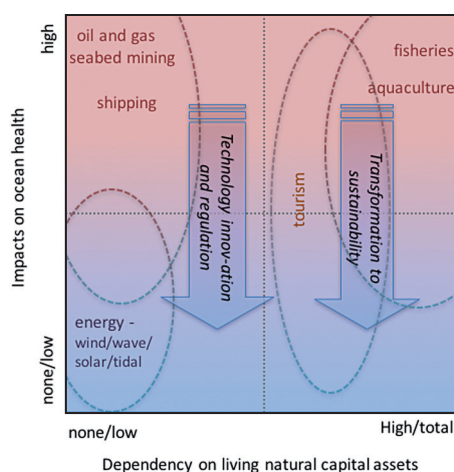
into low-impact sectors may relate to: incentivising sustainable practices; promoting innovative methods and production practices to minimise impact; and investing in value-chain and market instruments that reduce the environmental impact.

Mining and shipping sectors have low to zero dependence on ecosystem function, and have traditionally been in the high-impact quadrant, as historically many polluting and destructive consequences were treated as externalities (Figure 17.8). The need for their costs to be internalised, for example, through the polluter-pays principle and use of cleaner fuels, is at the heart of new thinking about aspects as diverse as production cycles and climate change.⁶⁶

Renewable sources of energy – wind, solar, wave and tidal – represent a new frontier for the energy sector for Indian Ocean rim countries, and currently great tension exists between these and traditional energy sectors (fossil fuel, and especially coal), as countries struggle with predicting the direction the next two to three decades will take for energy production and consumption. This has profound repercussions on the massive infrastructure investments that must be made to provide sufficient energy to fuel future development and national populations. At the same time, avoiding costly ‘white elephant’ legacy infrastructure for fossil fuel resources that may become obsolete before they return on their investment needs to be a key planning concern. In addition to this, the high pollution levels from fossil fuels, both of carbon dioxide (in relation to reducing climate change drivers) and of pollutants (particularly from coal and petroleum), require that national planners very carefully consider their potential impacts on other ocean economy sectors.

A key perspective applicable to businesses that can drive the required transformation is the switch from traditional to circular economic principles.⁶⁷ Traditional economic models are essentially linear, taking raw materials from nature, often without any payment for the raw material itself, other than access fees. The raw material is then processed in a linear chain to the final consumer and disposal, with a range of by-products and end-products that are treated as waste, which are

Figure 17.8: *Schematic of Dependence of Major Economic Sectors on Ocean Natural Capital Assets (horizontal axis) and Impacts on Ocean Health (vertical axis)*⁶⁵



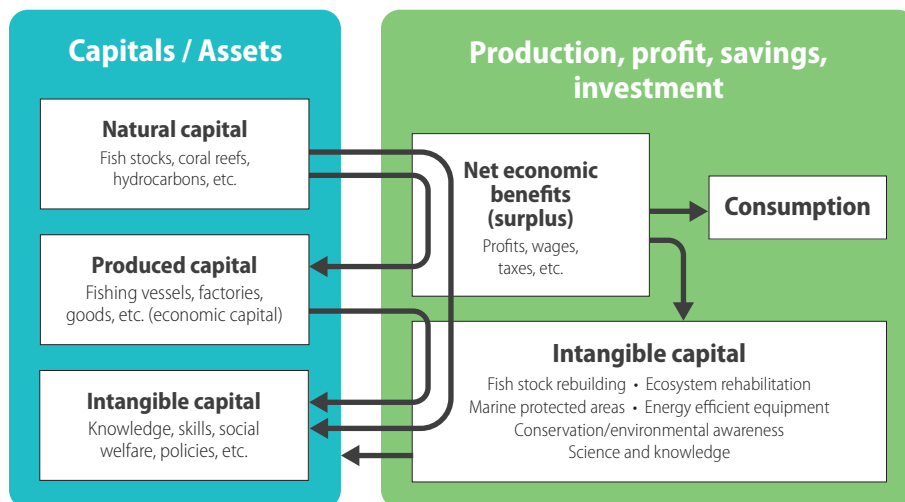
dumped in the environment - again often without costing the impact of this waste to nature or to people.

The circular model accounts for raw materials as products of natural processes, and treats all by-products and end-waste products as inputs to further processes, so that waste is minimised to the greatest degree possible. This is synonymous with the sustainable Blue Economy approach, which treats ecosystem goods and services as finite and valuable inputs, and ensures impacts and waste are minimised to ensure sustainability. Coupling business-oriented circular economy principles with national Blue Economy planning provides mechanisms for building sustainable economic practices from the smallest enterprises to regional governance processes.

Finance and investment in ocean health

Finance for Blue Economy investment will need to be provided on a large scale, and from both public and private sector sources. Increased attention to public-private partnerships (PPPs)^{68,69} that merge the interests of all stakeholders, from local to global, provides promising avenues. However, motivating for appropriate levels of finance will be a challenge. Again, a focus on natural capital assets will facilitate this, as the investment approach of identifying the cost of maintaining an asset should unlock finance from the wealth and profits derived from the asset. A proportion of all profits should be used to invest in asset management - a principle firmly embedded in financial and equity systems.

The Blue Economy approach also provides a mechanism to justify diversion of profit from one sector, or asset, to finance the maintenance, restoration or building up, of other Blue Economy assets (Figure 17.9). This entails more enlightened reinvestment strategies, and portfolios targeting asset growth and management, rather than profits.⁷⁰ For example, oil and gas extraction should certainly pay for and reduce to zero all impacts from its activities, but the high levels of profit can also be used to build up other assets and sectors, such as sustainable fisheries and aquaculture.⁷¹ This is not only rational with respect to the balanced approach of the Blue Economy, but also with respect to a long-term investment perspective on many levels, because it builds up national sectors, the environment, and economic and social assets that may be of greater importance once assets such as oil and gas reserves are exhausted, or become obsolete as technologies change over many decades.

Figure 17.9: *Different Capital Assets that Produce Profits and Resources for Investment*⁷²

Many new tools and practices are under development, offering innovative solutions for sustainable finance in relation to ocean assets and climate change. These include the blue carbon approach, which is based on monetising the climate service functions of marine ecosystems in sequestering carbon.⁷³

The regional approach to maintaining ocean health

As is explicit in the concept of the Blue Economy, planning and implementation must occur at scales relevant to ocean systems, whereas the natural tendency is toward national scales of economic planning (see national case studies above). Nevertheless, both Asian and African participants recognise the growing need for regional and sub-regional integration in improving development, and implementing Blue Economy approaches.^{74,75} The whole-basin scale is the largest scale that is relevant for the Indian Ocean, but the regional scale of sub-units determined by ocean processes and specific challenges is likely to be more pragmatic.⁷⁶ The Large Marine Ecosystem approach⁷⁷ is one that has successfully identified an appropriate scale for the consideration of ecosystem, economic and human dimensions, and has led to funding from the Global Environment Facility of just over US\$6 billion for the period 1995-2018.⁷⁸ Another example is the regional seas scale, implemented by the United Nations Environment Program (UNEP) in the 1980s,⁷⁹ and validated recently in the context of United Nations Agenda 2030.⁸⁰ Inter-country planning and negotiation processes, covering waters within national jurisdictions, must be expanded and strengthened to meet the challenges involved. An emerging challenge

is the governance of international waters, where impacts from unregulated or damaging exploitation may undo benefits achieved within government jurisdictions, and a novel framework is being developed through on-going UN processes.⁸¹

Table 17.3: *Regional Divisions Established by the Large Marine Ecosystem and UNEP Regional Seas Processes in the Indian Ocean Basin*

Large Marine Ecosystems	UNEP Regional Seas
Agulhas Current	Eastern Africa (Nairobi Convention)
Somali Coastal Current	Red Sea and Gulf of Aden (Jeddah Convention)
Arabian Sea	ROPME Sea Area (Kuwait Convention)
Red Sea	South Asian Seas
Bay of Bengal	East Asian Seas
Gulf of Thailand	

Source: Author's own formulation; see also endnote 81.

Sustainable development goals (SDGs) provide an unprecedented platform for the integration of sectors, and for balancing the economic, social and environmental benefits that the Blue Economy approach embodies. Early analysis of the value of SDGs focused on interactions between, for example, the energy sector and ocean health.⁸² But as the SDG debate has matured, more precise targets and indicators are being specified, and the opportunity to use these as signposts for Blue Economy development,⁸³ and for diversified metrics to measure progress, is becoming clearer. In addition, the United Nations Ocean Conference, held in June 2017, focussed on SDG 14 (to 'conserve and sustainably use the oceans, seas, and marine resources for sustainable development') and provides a unique opportunity to advance the Blue Economy debate globally.

IORA is uniquely placed to facilitate and promote regional institutional mechanisms of governance and management of ocean resources in the Indian Ocean basin. It is the only institution focused on the entire basin, with membership from countries all around the rim of the basin, and engagement of other countries with interests in the ocean basin. It cuts across sectors, such as diplomatic, production and sustainability. The regional initiatives listed above (UNEP Regional Seas and Large Marine Ecosystems), economic bodies such as regional Economic Commissions, as well as regional fisheries bodies and others (including those covering the high seas), all fall within the geographic scope of IORA. Member states and interested parties in these domains may be brought together under the umbrella of IORA, to assure alignment and sustainable management of shared stocks and

resources. It is now widely accepted that the emerging challenges of the 21st century need new and innovative mechanisms for governance and alignment among countries,⁸⁴ and IORA presents a potential solution to facilitate these new solutions in the Indian Ocean basin through the lens of the Blue Economy.⁸⁵

Conclusion

The varied pressures and demands on ocean sectors, which have led to the current decline in ocean health (and state of ocean assets) are all projected to increase. Unless strong leadership and decision-making emerges, there is a real risk of pursuing a 'weak' or unsustainable Blue Economy approach. Challenges to a sustainable Blue Economy are embedded in a cohort of practices from past decades of economic practice,⁸⁶ which can be described as 'linear', i.e.: raw materials are over-exploited, pollution is returned to the environment, fossil fuel use is high, and there is a lack of attention to the consequences of demographic change (including population growth and unmanaged migration). In addition, planning is primarily sectoral and economic priorities focus on profit rather than sustainability.

An alternative model provides opportunities for transformation and a focus on sustainable economic development, and can be described as 'circular', with a focus on transformation to renewable and efficient energy models. Population growth and coastal migration are considered, planning is integrated across sectors, and on the priority is long-term sustainable prosperity.

Currently, the Blue Economy is described in some circles as the sustainable subset of the coastal and marine economy.^{87,88} However, the goal should be to make the entire ocean economy blue,^{89,90,91} in the same way as all terrestrial economy sectors should be transformed to green. Principles and guidance to support this process have been developed. This is a unique time and opportunity for IORA to take the lead in policy development on sustainable Blue Economy in the Indian Ocean, at basin and regional levels, and lead the transformation into an environmentally sustainable, socially equitable and economically viable future for Indian Ocean rim countries.

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Environmental Sustainability and the Ocean Economy

A Case Study of Mauritius

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Introduction

The Earth - also known as the blue planet - has 71 per cent of its 510 million km² surface covered by marine waters, with an average depth that is four times the average elevation height of the land.¹ In many parts of the world, the oceans, seas, and rivers are highly exploited, in order to provide livelihoods and employment to millions of people and to conduct 90 per cent of the world's international trade. The United Nations Economic Commission for Africa (UNECA) has reported that the worldwide market for marine biotechnology will reach US\$5.9 billion by 2022.² This will be achieved by increased investment in marine biotechnology research for the development of new foods, pharmaceuticals, bio-energies and cosmetic products.³ Globally, around 30 per cent of oil and gas production emanates from offshore resources, and with increasing demand for energy, the ocean will remain a priority sector in the future.⁴ In addition, the oceans regulate the climate and the functioning of coastal marine ecosystems (such as mangrove and kelp forests, seagrass meadows and salt-water marshes), and they store and sequester atmospheric carbon.⁵

However, the oceans are facing substantial ecological risks, such as: a rise in sea level because of climate change; acidification of oceans from increased emissions of carbon dioxide; over-exploitation and poor management of marine resources, including fisheries; wastewater run-off; pollutants deposited into waterways; and mineral resource extraction from the seabed.⁶ These risks eventually have a significant impact on the social and economic prospects of many countries, particularly coastal nations and Small Island Developing States (SIDS). Furthermore, around 350 million jobs are directly associated with the oceans in terms of fishing,

aquaculture, coastal and marine tourism, as well as research work. Over-exploitation and poor management of marine resources will lead to lost opportunities, heightened food insecurity and diminished economic opportunities for some of the world's poorest people.

As such, there is a need to sustainably use the oceans for poverty reduction, food security, livelihood improvement and mitigation of climate change. In order to establish a balance between competing ecological and economic imperatives, the concept of a sustainable ocean economy (also known as the Blue Economy) was established to promote economic growth, environmental sustainability and social inclusion, as well as to strengthen ocean ecosystems. The Blue Economy was endorsed at the United Nations Conference on Sustainable Development, which was held in Rio de Janeiro in 2012.⁷ The concept of a 'Blue Economy for sustainable coastal development' involves the introduction of more innovative technologies that are expected to generate new cash flow, and consequently new jobs, as well as attract investors.⁸ The Blue Economy is a social system that was created through a concentrated process. The phrase was coined based on the idea of the beautiful blue sky and blue oceans of planet Earth, as long as pollution is kept to a minimum.⁹

The Republic of Mauritius has an Exclusive Economic Zone (EEZ) of 2.3 million km² and co-manages 396 000 km² of continental shelf, along with the Republic of Seychelles. This means that the Republic of Mauritius ranks among the largest economic territories in the world.¹⁰ In 2013, the Government of Mauritius decided to adopt the ocean economy as the next pillar of the Mauritian economy, in the hope of ensuring sustainable and coordinated utilisation of living and non-living resources in various sectors, such as tourism, seaports and seafood-related activities.¹¹

In 2015, the ocean economy was identified as one of the main components of the Mauritian government's Vision 2030.¹² 'Leveraging on the exclusive maritime economic zone to develop the ocean industry' was seen as one of the key pillars of the Prime Minister's economic mission statement, when he established the 'Achieving the Second Economic Miracle and Vision 2030' committee.¹³

Port Louis harbour will be developed as a major port for the region so as to handle much higher traffic and other port-related activities. With regard to the fishing sector, the government is negotiating with major international fishing companies for the setting up of fishing and seafood processing facilities locally.¹⁴

A 'Ministry of Ocean Economy, Marine Resources, Fisheries, Shipping and Outer Islands' was created and is dedicated to ocean-related activities. This subsequently led to the development of legal and regulatory frameworks for the monitoring of ocean economy operators.¹⁵ The government's stated mission for the ocean

economy was to set up a National Ocean Council (NOC) as the driving force of the ministry, and also to formulate a national ocean policy paper, in order to develop the sector in the short, middle and long term. The main objective is to promote job creation and expand economic activities in a planned and sustainable manner. As per the President's address on 27 January 2015 regarding the government plan for 2015 to 2019, it was stated that a legal and regulatory framework will be put in place to license, supervise, monitor and regulate the activities of ocean-related economic operators.¹⁶

The Mauritian budget (2016-2017) provides for various initiatives for the expansion of the ocean economy, including aquaculture and fish processing development, and the acquisition of multi-purpose vessels for promoting outer-reef and bank fishing.¹⁷ The Mauritius Seafood Hub, which includes fishing, transshipment, storage and warehousing, light processing, canning, and ancillary services (shipchandelling, bunkering, vessel husbandry, ship agency, ship building and repairs), provides an efficient and effective environment for the supply of value-added processes and services related to sourcing, processing, distribution and re-export of seafood products. For instance, 63 362 tonnes of seafood was exported in 2015, which represented 16 per cent of Mauritius' total exports. Europe is the main export market for seafood, as Mauritius offers high value-added seafood processing that complies with European Union Regulations, Hazard Analysis and Critical Control Points (HACCP) and British Retail Consortium (BRC) standards.¹⁸

With a view to strengthening its commitment to the development of the ocean economy, the Government of Mauritius organised the 'African Ministerial Conference on Ocean Economies and Climate Change', which was held at the beginning of September 2016. Attended by 19 countries and 24 key organisations, this conference focused mainly on the importance of improving the climate resilience of African oceans, as well as on SIDS with large maritime zones and a high dependency on the oceans for their economic development. This initiative positioned Mauritius as a leader in African ocean economic forums, and helped attract institutional donors and partners for Blue Economy and climate change projects.¹⁹

International initiatives that followed the sustainability agenda include the Indian Ocean Rim Association (IORA), the Samoa Pathway, the African Union Agenda 2063, and the Seychelles Blue Economy. IORA groups 21 countries that surround the Indian Ocean into cooperative entities. In 2015, during the Blue Economy Ministerial Conference held in Mauritius, entitled 'Enhancing Blue Economy Cooperation for Sustainable Development in the Indian Ocean region', a declaration of cooperation was signed. The objective of IORA is to place emphasis on fisheries and aquaculture, renewable ocean energy, seaports and shipping, as well as offshore hydrocarbons and seabed minerals, in order to promote the Blue Economy concept as a driver of sustainable development. This will, in turn, encourage research and development

investment, technology transfer and capacity building in the Indian Ocean Rim region, which is in line with the United Nations' Sustainable Development Goal (SDG) 14. SDG 14's targets include reducing pollution by 2025, and sustainably managing and protecting marine ecosystems, promoting sustainable practices, and minimising the impact of ocean acidification by 2020.²⁰ The Samoa Pathway (Small Island Developing States Accelerated Modalities of Action) was adopted by the UN General Assembly in 2014 as a resolution to the outcome document of the Third International Conference on SIDS. Key recommendations include conserving at least 10 per cent of the coastal and marine areas of SIDS by 2020, through:

- designated protected areas and area-based conservation measures;
- addressing marine pollution and building resilience to invasive species;
- implementing sustainable use and management of highly migratory fish stocks;
- protecting coral reefs and other vulnerable marine ecosystems; and
- furthering scientific research and technical capacity-building.²¹

The Mauritian government's Vision 2030 has already paved the way to meeting the vision of Agenda 2063 of the African Union. The African Union Commission reported that the ocean will be a key contributor to continental transformation and growth.²² The report also stated that this could be achieved by: creating awareness of marine and aquatic biotechnology; building an Africa-wide shipping industry; developing sea, river and lake transportation and fishing; and exploiting deep sea minerals and other resources.²³ In its 'Harnessing the Blue Economy in Achieving the African Union Agenda 2063' strategy paper, the African Union pledged to develop the Blue Economy as one of its pillars, by making 2015 to 2025 the decade of African seas and oceans and of implementing the Africa Integrated Maritime (AIM) Strategy²⁴.

The Seychelles was the first island in the Indian Ocean to adopt the Blue Economy, and to develop strategies to access the full potential of its ocean territory. The Seychelles' definition of the Blue Economy refers to all economic activities that directly or indirectly take place in marine and coastal areas, use outputs from the ocean, and put goods and services into ocean activities.^{25,26} The government of the Seychelles has also developed a strategy document titled, 'Seychelles' Blue Economy Roadmap: Defining a Pathway to Prosperity'.²⁷

Environmental impact of Blue Economy industries

The Blue Economy was recognised during the Third International Conference on Sustainable Development, Rio+20 (2012).²⁸ The Blue Economy, as defined here,

is mainly related to the following industries: shipping, shipbuilding and marine equipment, capture fisheries and fish processing, maritime and coastal tourism, conventional offshore oil and gas exploration and production, dredging, and port facilities and handling.²⁹ Ocean economy industries are defined differently by different countries, but a general approach can be described as follows:³⁰

- Industries forming part of the ocean economy are defined.
- Industries are identified through the use of data from national databases.
- The proportion of the ocean/marine related economic activity is estimated.
- The estimated expenditure in the marine economy is recorded, for example in USA (employment, number of establishments, earned wage and productivity numbers).
- Official government estimates are compared with available information from industry sources.

During the first IORA Ministerial Blue Economy Conference, which was held in Mauritius, four major sectors were identified for the development of the Blue Economy. These are: (1) Fisheries and Aquaculture; (2) Renewable Ocean Energy; (3) Seaports and Shipping; and (4) Offshore Hydrocarbon and Seabed Minerals.³¹ These priority sectors are also cross-cutting for SIDS as well as for Least Developed Countries (LDC) and Ocean Knowledge Clusters.³²

The development of the ocean economy in Mauritius has the target of creating 25 000 jobs by 2030 in ocean-related sectors.³³ As tourism has always been an important pillar of the Mauritian economy, there are plans to further expand the sector.³⁴ Development of the cruise industry by attracting cruise ships from Europe is also envisaged. Furthermore, local universities and research institutes (such as the Albion Fisheries Research Centre, the Mauritius Oceanography Institute, and the Mauritius Research Council) are undertaking research projects with a view to developing marine biotechnology industries. However, it should be noted that these industries will also have a significant impact on the health of the marine ecosystem and the surrounding environment, in either the short term or the long term.³⁵

Fisheries and aquaculture

Fish industries are an important sector of global trade. The percentage increase in global trade in fish and fish products has been 12 per cent on average in recent decades.³⁶ Worldwide demand for fish and fish products is expected to increase as a result of growing populations and rising buying power.³⁷ Aquaculture represents

the most convenient approach to meeting future global demand. The United Nations Food and Agriculture Organization's (FAO) optimistic scenarios assume a 58 per cent increase in aquaculture production by 2022.³⁸

Marine fisheries are a very important sector for SIDS, especially in terms of income generation, and in 2012, fish exports by SIDS reached 1.7 per cent of their total gross domestic product (GDP).³⁹ In Mauritius, fisheries represent about 1.5 per cent of the national GDP, with some 16 000 people working in this sector.⁴⁰ The introduction of marine aquaculture in SIDS can undeniably reduce overfishing and restore marine ecosystems, as well as increase their GDP.

The strategy for Mauritius' marine industry is based on sustainability, expansion of the industry, the development of value added fisheries and seafood, and higher value throughout related sectors, including fishing, transshipment and ancillary services.⁴¹ Also, new sites for aquaculture are being identified, with emphasis on the involvement of the private sector, as well as expansion of the existing marine farm at Mahébourg. Businesses, including spirulina and mollusc culturing, are being planned.⁴² However, it must be noted that aquaculture can contribute to the exhaustion of the stock of wild fisheries.⁴³

Marine aquaculture will help us meet future global demand,⁴⁴ but its environmental threats cannot be ignored. The uncontrolled development of coastal aquaculture can have a negative impact on wetlands, impeding coastal habitat conservation,^{45,46} which is especially problematic as fish health is entirely dependent on water quality. Untreated effluent and heavy metal residues can contribute to the accumulation of toxic residues in aquaculture, and enter the entire food chain.^{47,48} Moreover, aquaculture effluent contains a high amount of organic matter, which can stimulate eutrophication and serious algal growth, and affect the ecosystem.^{49,50,51} Moreover, there is, at present, no control of the use of antibiotics in aqua-feeds, which can result in the development of bacterial resistance.^{52,53} Finally, farmed fish escaping from aquaculture farms may cause socio-economic and ecological problems.⁵⁴ Hence, it is of the utmost importance to understand each stage of the cycle of the cultured species, as well as the related environmental impact.⁵⁵

IORA member states are aware of the need to develop sustainable aquaculture. A training programme has been developed. Its objectives are to: promote the sharing of knowledge and technology transfer among IORA member states; enhance the development of the marine aquaculture sector; and increase awareness of sustainable aquaculture and the environmental impact of conventional aquaculture, to ensure food security.⁵⁶

Renewable ocean energy

According to the United Nations Conference on Trade and Development (UNCTAD), the demand for ocean renewable energy (such as offshore wind, tide, and wave energy; marine biomass energy; and submarine geothermal energy) will increase 2.5 times by 2035, in order to meet climate change mitigation objectives.⁵⁷ The global growth of offshore wind energy is projected to have a potential installed capacity of 40 to 60 GW by 2020.⁵⁸

The use of ocean renewable energy by SIDS will undeniably help to decrease their dependence on imported fossil fuels, as well as contribute to their level of energy security. In Mauritius, a resource assessment and exploitation plan has been developed by the Mauritius Research Council (MRC), with the support of the World Bank, and the Commonwealth Secretariat. The first phase includes the setting up of a decentralised micro grid and desalination system in Rodrigues, a neighbouring island to Mauritius. A collaborative agreement has also been signed with Carnegie Wave Energy Ltd (Australia) to develop commercial wave energy applications using Greek Ocean Goddess (CETO) technology, where buoys are installed at several sea levels and, by virtue of their movement, they create momentum for onshore power generation. The MRC also conducted a preliminary study of offshore wind and offshore wave farms, which demonstrated that this technology is feasible in Mauritius, as well as in Rodrigues.⁵⁹ The Deep Ocean Water Applications Project (DOWA) Seawater Air-Conditioning Scheme, which consists of developing a seawater air conditioning system as a cooling service for public buildings in the capital city of Port Louis, is currently being developed by Urban Cooling Ltd.^{60,61,62}

The primary negative effects of ocean renewable energy occur mainly during the construction phase, and can lead to an alteration of the benthic habitat, resulting in biodiversity loss.^{63,64,65,66} The artificial structures used often attract opportunistic species that are likely to dominate and rapidly colonise into the environment.⁶⁷ Moreover, the submerged or semi-submerged turbines can cause physical injury to marine animals, as well as to seabird species that are foraging.⁶⁸ Anthropogenic noise is of particular concern during the construction and decommissioning phases. Sound is important to most marine animals and the generation of underwater noise due to construction and boat trafficking can result in behavioural changes, and also disturb communication and breeding activities.^{69,70,71} Electromagnetic field emissions from cabling routes may disturb the orientation of fish, which use magnetic fields for movement.⁷² Migrating fish are the most vulnerable to the disturbance, since the electromagnetic field can disrupt their migration routes.^{73,74,75}

Energy production from tides and waves can have a negative effect on the environment. The extraction of power reduces the kinetic energy of sea currents,

which affects the transportation of food and gases for both aquatic animals and plants.^{76,77} In addition, the deployment of these energy projects requires a range of compounds, such as lubricants and anti-corrosion coatings, to resist the harsh environment. Studies have shown that some of the chemicals present in these compounds can have a harmful effect on marine biota.⁷⁸ Boat traffic during the construction and decommissioning phases, as well as maintenance, can affect water quality due to oil leakages or accidental chemical release, resulting in toxicity impacts or altering marine biota behaviour.⁷⁹ Also, the increase in sediment suspension levels and turbidity during the construction phase can decrease the penetration of light, interfering with the photosynthesis process in aquatic plants.⁸⁰ Seawater temperature can be influenced by the alternating water column stratification process used during tidal energy harvesting. This can result in uncontrolled growth of phytoplankton, which can be toxic to marine biota, and to humans.⁸¹

Seaports and shipping

Seaborne trade is expected to increase by four per cent globally over the period 2020-2029, with long term growth in container traffic, but a decrease in tanker and bulk cargos.⁸² IORA member states have shown great interest in the seaport and maritime transport sector.⁸³ However, there is uneven distribution among the member states in terms of congestion, new technology and equipment, port infrastructure and professional services.⁸⁴ In Mauritius, the government is looking to extend the container terminal quay at Mer Rouge, Port Louis, with the aim of using Port Louis as a hub.⁸⁵ The Mauritius Ports Authority (MPA) has already started work on extending the quay by 240m, expanding the container stacking yard by 7.5Ha, and strengthening the existing 560m long berth of the quay, using Belgian contractors Dredging, Environmental and Marine Engineering Group (DEME). The MPA is also looking into the extension of the Fort George site, also in Port Louis, by 4Ha for bunkering activities.⁸⁶

The environmental impact of seaport expansion, activities and shipping cannot be overlooked. The construction phase will undeniably affect coastal hydrography, leading to coastal erosion at adjacent beaches.⁸⁷ The dredging process during construction could also disturb, and possibly even destroy, marine biota. Oil spills, the emission of toxic chemicals, ballast water and other waste could have a significant impact on the marine environment. Other impacts are noise and air pollution, traffic congestion and hazards from handling dangerous goods.⁸⁸

Offshore hydrocarbon and seabed minerals

According to The Organisation for Economic Cooperation and Development (OECD), oil and gas are expected to provide around 50 per cent of the world's energy mix in 2040, and 30 per cent of global hydrocarbon generation. Hence, there will be increased interest in deep water oil and gas extraction in the next 15 years. Gas extraction is expected to reach 27 barrels of oil-equivalent per day (mboe/d) in 2040 (compared to 17 mboe/d in 2014) from both shallow and deep water.⁸⁹

Mauritius depends solely on imported petroleum product to meet its energy requirement. According to CSO 2016, Mauritius' energy demand (84 per cent fossil fuel and 18.4 per cent renewable sources – hydro, wind, photovoltaic, bagasse, landfill gas and wood) increased by 2.8 per cent from 2014 to 2015, and the energy demand is expected to continue to increase.⁹⁰ In 2013, the Seychelles and Mauritius cooperated in the exploration of oil in the 396 000 km² around their respective coasts, although the legal framework for this is still under review.⁹¹ Currently, the Department of Continental Shelf, Maritime Zones Administration and Exploration is working toward establishing an extended continental shelf in the Rodrigues region, as well as in the Chagos Archipelago region.⁹²

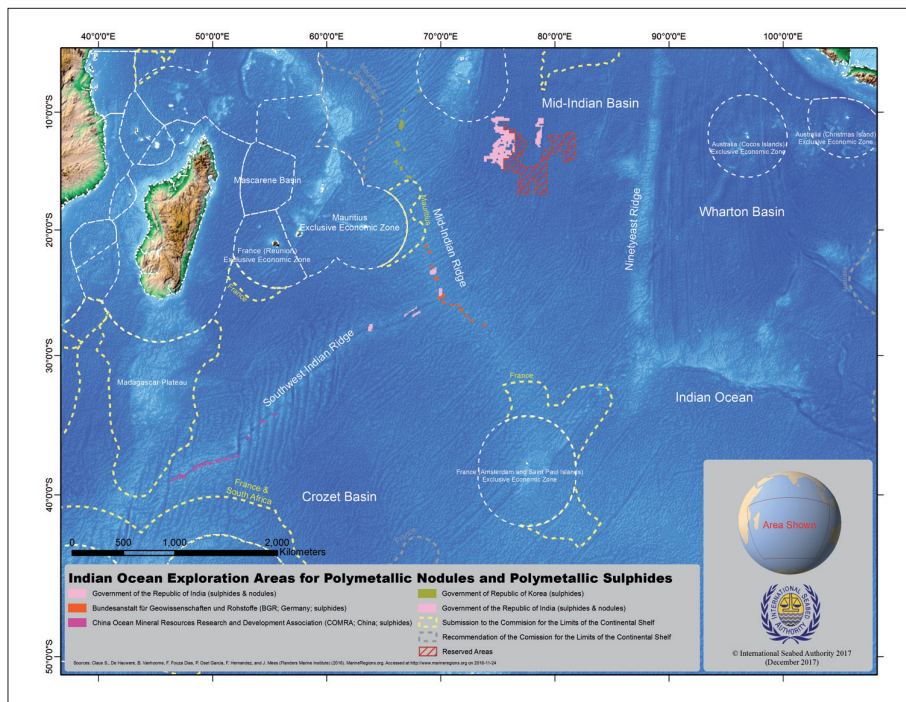
Environmental impacts from oil and gas extraction primarily concern benthic disturbances, habitat loss and depleting natural resources.^{93,94} Drilling has various environmental effects, such as chemical contamination (from heavy metals, hydrocarbons and more), resulting in toxic accumulation in some marine animals, and entering the food chain. Mud from drilling affects marine invertebrate larvae. There is also the risk of accidents, such as explosions or leakages, which could affect the ecosystem. It should be noted that the consequences of the environmental impact of such accidents depends on the frequency of occurrence.⁹⁵

The exploration of deep sea mining has also become of great interest to the world. Currently, mineral extraction is carried out in shallow water less than 300m deep. According to OECD, mineral extraction from the deep sea is mainly concerned with manganese nodules, cobalt-rich ferromanganese crust, and seafloor massive sulphide (SMS) deposits. Presently, there is no commercial deep-sea mining activity, but there are some exploration projects, which are mostly located in the Clarion-Clipperton zone of the east-central Pacific. There are, however, also four in the Indian Ocean, two in the Atlantic Ocean and two in the northwest Pacific Ocean.⁹⁶ Two companies, namely Nautilus Minerals and Neptune Minerals, hold the license for SMS exploitation within the EEZs in the southwest Pacific, while other countries are submitting their applications.^{97,98} The first deep-sea mining project might start in 2019 in Papua New Guinea's waters.^{99,100}

The exploration of deep sea mining is very limited in the Indian Ocean, as shown in Map 18.1. Some IORA members, such as Australia, India and South

Africa, have already mapped deep-sea mines in their EEZs, while other member states have limited capacity to explore their seabed resources. Seabed exploration is becoming more and more important for both government and industry, as governance, investment and appropriate legislation are closely linked.¹⁰¹ Mauritius is interested in exploring mineral deposits (such as polymetallic nodules, sulphides and cobalt-rich ferromanganese) in International Seabed Authority (ISA) waters, which are outside the limits of national jurisdiction.¹⁰²

Map 18.1: *Exploration of Deep Sea Mining in the Indian Ocean*¹⁰⁵



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Mauritius' main strategic plans for 2016 to 2020 are to:

- 1) develop the legal and regulatory framework for the Joint Management Area (JMA);
- 2) conduct a geotechnical survey and evaluation of hydrocarbon prospect;
- 3) develop a strategic environmental management plan for the JMA, as well as an inventory of living and non-living resources;
- 4) implement a Marine Exploration Plan;
- 5) compile and analyse oceanographic and geological parameters for the identification of oceanic processes;

- 6) promote the JMA as a frontier region for oil and gas prospection; and
- 7) license concession titles for exploration.¹⁰³

Mauritius' Continental Shelf, Maritime Zones Administration and Exploration department (CSMZAE) has launched an 'international expression of interest for multi-client geotechnical surveys' to collect seismic data for hydrocarbon and mineral exploration in the EEZ. Also, Maritime Zones (Marine Scientific Research) regulations are now in force. These are related to both national and international research within the maritime zones of the Republic of Mauritius. An 'Offshore Petroleum Bill' and a 'Seabed Mineral Bill' are currently being developed at the CSMZAE.¹⁰⁴

As the world's largest ecosystem, the deep seafloor is a reservoir of biodiversity. Its habitats are highly sensitive to any change in the environment, as they all share the same ecological characteristics.¹⁰⁶ If and when mining starts, one of the direct environmental impacts would be on the seafloor biota through noise pollution.¹⁰⁷ Light is another direct impact and it may alter the vision of deep sea organisms and change their behaviour.¹⁰⁸ Mineral mining would also cause the water to become turbid, because of the high concentration of metals; this could affect the benthic biota, reduce bioluminescence, and result in bioaccumulation of toxins.¹⁰⁹ Apart from these dangers, minerals have a relatively low recovery potential, thus the most obvious direct impact will be depletion, which would take millions of years to recover.¹¹⁰ According to Levin *et al.*, the change in deep-sea ecosystems may have a cumulative impact on climate change.¹¹¹ Moreover, deep sea mining might interfere with the hydrothermal vents and a break in connectivity could result in a loss of biodiversity and other serious ecological consequences in the marine environment.^{112,113,114}

Environmental management tools

The ocean is becoming a new economic frontier. Environmental management tools applied to the development of the ocean economy will help in addressing many aspects of ecosystem services and ecosystem-based management.

1. Marine spatial planning

The development of the ocean economy offers various investment opportunities to the different stakeholders in Mauritius' maritime sector. However, with the high level of investment and economic development to be made in that particular sector, it is of prime importance that a mechanism is developed in order to strike the right

balance between economic development and preservation and protection of the marine environment. Marine spatial planning (MPS) could be used as the operational tool to find the right compromise between the exploitation and exploration of marine resources for economic development, and preservation and protection of the marine environment.

MSP can be defined as the division of a marine space with the objective of regulating and managing the use of the sea in order to promote economic development and at the same time achieving social and ecological objectives.¹¹⁵ As an ecosystem-based management approach, marine spatial planning plots out where and when economic activities can be undertaken within marine spaces,¹¹⁶ as undertaking aggressive and unsustainable economic development within those spaces can be lethal to the ecosystem. MSP ensures there is a framework that will provide for the kind of economic activity to be undertaken in a given space, a time frame for its realisation, and the measures to be adopted for the protection of the ecosystem present therein.

Three stages of execution have been identified by Ehler and Douvère for successful application of MSP.¹¹⁷ These are planning and analysis, implementation, and monitoring and evaluation. During the planning and analysis phase, spatial plans for a marine space are designed. These take both the environmental and human aspects involved into consideration. The planning and analysis stage allows for the elaboration of a planning strategy that will provide equilibrium between the sustainable use of marine resources for economic development purposes and the protection of the marine environment. During the implementation phase, the spatial plans are carried out. Changes can be brought to them through regulation and incentives. The last stage involved in the process is monitoring and evaluation. At this stage, an assessment of the effectiveness of the implementation of the plans is carried out. The purpose of the monitoring and evaluation stage is to have an overview of the performance of the MPS. The outcomes, as well as whether the execution of the plans within a particular time frame has been respected, are monitored and evaluated. Recommendations are then made to improve the existing plans and adaptation procedures can be adopted. The implementation of MPS would be beneficial for Mauritius in the development of its ocean economy as it provides the operational tool that will allow Mauritius to regulate the economic activities taking place within the country's EEZ in a sustainable way

The first advantage of using MSP is that it provides a framework that finds equilibrium between marine environment protection and the sustainable use and exploitation of marine resources. For instance, in fishing or aquaculture, the application of MSP will allow for zoning of where these economic activities can take place on a long term basis, without hindering the ecosystem present in that zone. One key component for the successful implementation of MSP is the involvement

of all stakeholders in the decision-making process. This gives every stakeholder involved in the development of the Blue Economy opportunities to share their views and concerns. It brings a level of transparency to the decision-making process and reduces conflict between the various parties involved. Notwithstanding the advantages discussed above, the implementation of MSP in Mauritius does represent some challenges. The first is linked to the lack of local infrastructure and technical expertise for both short and long-term follow up of MSP implementation. International assistance is, most of the time, required to set up the plans and ensure the monitoring of MSP. This, in the long term, can amount to a heavy cost for the host country.

In the Seychelles, the MSP initiative is focussed on sustainable planning and management, long-term use, as well as the health of the Seychelles EEZ, which encompasses the Seychelles archipelago of 115 islands, and covers an area of 1 374 000km². The MSP initiative uses an integrated and multi-sectored approach (including fishing, tourism, conservation and petroleum development), so as to develop a holistic climate-smart multi-use management plan.

The Seychellois MSP offers a realistic and clear way to promote sustainable use of marine space and the interactions between its various sectors. It balances protection of the environment with demand for development, and it attains social and economic objectives in a planned and friendly manner. The government is given a planning mandate to fulfil, and the participatory nature of MSP encourages interested and committed civil society, as well as private sector partners, to enter into the process as active participants and advisors.¹¹⁸

2. Marine ecological compensation

It is important to transform marine environmental management into marine ecological environment management, so as to attain sustainable development of the Blue Economy. In order to avoid ecological problems, there is a need to implement and establish a marine environmental protection plan, as well as a complete ecological compensation mechanism.

Ecological compensation is a management system that is characterised by economic incentives and based on the principle of internalising the external cost of economic activities. Qu *et al.* state that ecological compensation is there to enhance, sustain and re-establish the natural functioning of the ecosystem, as well as to regulate the distribution of environmental and economic benefits for stakeholders, generated by both protective and destructive activity.¹¹⁹ In addition, marine ecological environment management based on compensation mechanisms institutionally guarantees the protection of both marine ecology and the management and development of resources.¹²⁰ Qu *et al.* state that compensation

mechanisms should be integrated into law, tax administration, economic management, administrative management and management systems, in order to establish a proper marine ecological management system.¹²¹ In China, marine environmental protection law is of the utmost importance for compensation work. A policy has been established to: protect and improve the marine environment; protect marine resources; prevent damage due to pollution; maintain ecological balance; protect human health; and promote sustainable development for the economy and society.

3. Ocean environmental awareness (OEA)

Another perspective, offered by Umuhire and Fang, concerns the enhancement of public OEA, in order to increase support for the protection of ocean environments. They investigated current levels of OEA based on three features: concern for the ocean environment, knowledge of the ocean environment, and willingness to participate in ocean-related activities. They conclude that public education is critical for promoting sustainable development and improving the general public's capacity to address environmental and developmental issues. Moreover, they state that ocean literacy is an indispensable means of 'achieving environmental awareness, values and attitudes, skills and behaviour, consistent with sustainable development and effective public participation in decision-making'.^{122,123}

OEA will encourage the public, and other stakeholders, to get more involved in the development of ocean policy and implementation, thus leading to sustainable utilisation and management of ocean resources.¹²⁴ However, managing and maintaining all institutions that support ocean policy implementation at a regional level is a challenging task, particularly for developing countries, due to:^{125,126}

- *Lack of funding.* Developing countries have limited funds, which may be insufficient to support all the regional institutions they are members of.
- *Lack of capacity.* Developing countries have limited capacity to manage their own national administrations, let alone regional bureaucracies.
- *Ownership.* Some developing countries struggle with ownership of decisions that are based on advice from regional organisations.
- *Externalities.* Regional organisations are made up of different memberships, often including members that are also development partners, who are often better resourced to participate and contribute to regional meetings.

The results of the study conducted by Umuhire and Fang showed that education has a significant impact on OEA, as the students who showed higher willingness to participate in ocean-related activities had acquired knowledge from courses related

to ocean issues. Umuhire and Fang also found that geographical location plays an important role in the student's knowledge about the ocean environment, as those coming from coastal cities experience ocean life from childhood and are more familiar with it, compared to students from non-coastal cities. Gender also seemed to have an impact on understanding ocean-related concepts, with men being more likely to read ocean-related material than women. This study demonstrated how crucial education (formal and informal) is from an early age.¹²⁷

4. Environmental performance indicators

Nowadays, a lot of research interest is geared towards effective management of marine protected areas (MPAs). MPAs are mostly situated in coastal areas that have intense human activity (both extractive and non-extractive), as well as various pressures on the functions and services of the ecosystems. These areas need additional control measures on fishing (for instance vessel size restrictions, gear exclusion, catch controls) which may impact local fishing communities in the short-term.

Batista *et al.* thus recommended that the monitoring of fish catches before, during and after MPA implementation is essential, to document changes in fishing activity, and to evaluate the impact of MPAs on fishing communities.¹²⁸ An Environmental Performance Indicator (EPI) framework is considered a good means of MPA management planning and assessment.¹²⁹ A number of global, national, regional, and sectoral indicators related to environmental management performance and sustainability have been developed by a few significant initiatives, such as the International Organization for Standardization (ISO) 14031 Environmental Performance Evaluation (EPE), Pressure-State-Response (PSR), and D¼ driving force indicator; P¼ pressure indicator; S¼ state indicator; I¼ impact indicator; R¼ response indicator (DPSIR) frameworks.^{130,131}

The case of Jiaozhou Bay coastal wetland in China, which is still under development, was investigated as a special marine protected area (SMPA). Wu *et al.* aimed at establishing a conceptual model, and an operable EPI framework, for examining the SMPA's day-to-day management, and evaluating management effects on the wetland. An expert-ranking procedure was used to rank the initial indicators based on two evaluation criteria ('reliability' and 'feasibility'), and the number of indicators were reduced to produce a summative indicator set. It was also found that managers have vital responsibilities for strategic, operational and integrated environmental management.¹³²

In addition, operational objectives for the evaluation of management performance of spatially-managed areas need to be effective and SMART.^{133,134} That is, *specific* objectives should clearly specify the state to be achieved and they should be interpreted unambiguously by all stakeholders. *Measurable* - to measure progress,

objectives should clearly reflect the relationship between the measurable properties of ecosystems and human societies. *Achievable* – in order to be achievable, objectives should not conflict. *Realistic* – feasible implementation of objectives using the resources available to managers and stakeholders (research, monitoring, assessment and enforcement tools). *Time bound* - there should be a clearly defined time scale for meeting objectives.

A study of various evaluation models of port environmental performance, conducted by Roos and Neto, proposes a series of indicators for Brazilian public ports that consider both economic and financial criteria. They employed ‘exploratory approach’ and ‘constructive hypotheses’ methods in order to: understand port environment management strategies; identify application possibilities for Brazilian ports; and propose a system of indicators to use and check for professional applicability.

The proposed indicators for the initial phase of implementation were energy consumption, environmental fines, costs and investments in the environmental area, and environmental training. The indicators for environmental performance were wastewater treatment, disposal of solid waste, and recycling. The results of this study showed that environmental management is an important tool for improving sustainability at ports, and that indicators are important in evaluating environmental criteria. Nevertheless, in reality, environmental management at Brazilian public ports is obstructed by bureaucracy and the unnecessary complexity of environmental legislation.¹³⁵

Conclusion

With the depletion of non-renewable energy sources, and the over-exploitation of natural resources, the world’s maritime economic development is now being directed towards the concept of the Blue Economy, which is believed to be the future.

Vision 2030 indicated the Mauritian government’s interest in this economy, which encompasses:

- (1) marine commerce and energy, maritime security, transport and auxiliary services, infrastructure development, tourism, education and scientific research, ports and harbour management;
- (2) welfare of seafarers;
- (3) environment management and coastal protection;
- (4) the fisheries and aquaculture industries;
- (5) shipbuilding and ship repair industries; and
- (6) offshore exploration and exploitation.

Many bodies, such as IORA, the Samoa Pathway, the African Union's Agenda 2063, and the Seychellois Blue Economy, have undertaken initiatives to promote the Blue Economy concept for SIDS. For sustainable development of maritime economics, there is a need for the introduction of more innovative technologies that will eventually generate new cash flow, leading to the creation of jobs, and, consequently, building social capital.

IORA's Ministerial Blue Economy Conference held in Mauritius in 2017 prioritised four major sectors for the development of the Blue Economy in SIDS. These were:

- (1) fisheries and aquaculture;
- (2) renewable ocean energy;
- (3) seaports and shipping;
- (4) offshore hydrocarbon and seabed minerals exploration.

To help with sustainable development of these sectors, entrepreneurship was encouraged. It is therefore important to encourage investors to venture into projects associated with the Blue Economy. Ongoing projects carried out by the various actors help promote the ocean economy at national level, and (in the long-term) should lead to increased energy and food security, increased investment in ocean projects, and the development of sustainable partnerships.

Capacity building in Blue Economy sectors will address the human resources requirements of the future. In addition, scientific research in all areas of the Blue Economy will be crucial for the creation and transfer of knowledge, and will lead to the success of this pillar of the Mauritian economy. However, environmental impacts of Blue Economy-related activities cannot be overlooked, and so environmental management tools such as marine spatial planning, marine ecological compensation, ocean environmental awareness, and environmental performance indicators, are vital for the proper development of the Blue Economy. In addition, well-managed planning, analysis, implementation, monitoring and evaluation are also crucial. This entails the establishment and enforcement of proper policies and regulations that ensure the protection and sustainable improvement of the marine environment.

Furthermore, public awareness campaigns, such as ocean fairs, talks, conferences, workshops and advertisements (such as billboards on beaches and short videos), would support the sustainable utilisation and management of ocean resources. Last, but not least, a list of measurable indicators is required to keep track of environmental consequences, and to improve the environmental performance of these activities - for the protection of our blue planet.

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CONCLUSION

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As illustrated by the contributions in this ambitious volume, the Blue Economy is increasingly accepted as an important developmental paradigm by countries across the globe, although, as a theoretical construct, it faces a number of challenges and contradictions. It is also difficult, at this stage, to measure the contribution that the Blue Economy makes to gross domestic product (GDP).

The objective of this final chapter is to present some of the main conclusions and policy implications emerging from the contributions of the eminent scholars from different disciplines.* Although it is difficult to define the definitive 'core' of this concept, it is possible, in this collection of ideas and analysis, to identify a 'critical mass' that is increasingly accepted by scientists, academicians from a variety of disciplines, and policy makers. Some of the key trends identified in the Handbook are unpacked below, as we continue this journey of discovery. It is manifestly clear from all the chapters that oceans are critical to sustaining the Earth's ecosystems. Oceans are no doubt essential to human life and well-being, as they provide food security and income to billions of people, and act as a highway for global trade. Oceans drive economic growth and scientific innovation to the benefit of people across the world, and not only of those residing in coastal areas.

The Blue Economy as an Evolutionary Concept

The contributions in this Handbook demonstrate that the concept of the Blue Economy is evolutionary and not revolutionary. Debates on issues related to the Blue Economy can be traced back to the 1950s or even earlier. The Blue Economy

*Although there is no chapter dedicated to peace and security in the region, owing to the developmental nature of this volume, the editors again wish to emphasise that maritime safety and security is a pre-requisite for implementation of the Blue Economy, as it ushers in an era of prosperity, inclusive growth and productive employment generation in the Indian Ocean region and around the globe.

is seen by many to be a progression from the 'Green Economy' concept. Indeed, many small islands and coastal states have questioned the concept of the 'Green Economy' and whether it applies to them and their specific sustainable developmental challenges. Coastal and small island developing states (SIDS) have thus contributed substantially to the emerging developmental paradigm of the Blue Economy as being inclusive of the green, ocean, coastal and marine economies. This has great potential for 'blue growth' in the Indian Ocean region (IOR), as it focuses on long-term sustainability, improving human well-being and advancing social equity, while significantly reducing environmental risks and addressing ecological risks and scarcity.

Challenges of the Blue Economy

Paradoxically, the fundamental challenge of the Blue Economy is *simultaneously to do more and to do less*. Put simply, the Blue Economy should increase the overall wealth of nations derived from ocean and coastal resources, although increased wealth in fisheries (for instance) may require reducing fishing to biologically sustainable levels. Exploiting hydrocarbon and mineral resources may increase wealth today, but the effects may only be temporary if portions of the mineral wealth are not conserved for the future. As such, the Blue Economy is both a bold vision and an excruciatingly delicate balancing act. The Blue Economy Framework consists of five elements: investment, customers, management, innovation and measurement. The essential precept of the Framework is that all the elements must be addressed simultaneously, although efforts made with each will vary according to local circumstances. Furthermore, financial, physical, natural and human capital is needed to (sustainably) exploit the benefits of the oceans.

For high-income countries, the aspect of the Blue Economy with the greatest appeal to policy makers is the possibility of developing and deploying a wide range of innovative products and services based on ocean resources. This 'innovative' Blue Economy has been highlighted in Europe, Canada, and the United States of America. Technological innovation is emphasised in fields such as information and communication technologies (for instance the development of ocean observation and early warning systems), the development of technologies for deep seabed mining, the generation of renewable energy, and using biological materials from the oceans in the development of new pharmaceuticals. All of these possibilities are also relevant to lower-income countries, but the capacity for leading the research and development processes is limited in the latter countries.

The measurement of the economic value of oceans at the system (national) level is a rapidly evolving field of research that requires restructuring of national

data systems. Over the past decade, countries around the world have, in some way, adapted their national income and product accounts to identify and track the contributions of the oceans to national and regional economies. These efforts track the output of the Blue Economy on an annual basis and help address questions about the size of the Blue Economy relative to other industries/ sectors as well as growth trends over time. Further, the identification of ocean-based contributions to national and regional economies is the first step in measuring the Blue Economy, which requires ocean-related economic activities to be distinguished from non-ocean related economic activities.

The Blue Economy as an Alternative Developmental Paradigm

Against this background, there is growing convergence of opinion regarding the relevance of the Blue Economy as an alternative developmental paradigm that is capable of balancing global growth prospects against the sustainable management of constantly depleting natural resources. The global 'blue voice' that has grown in strength in recent years, following the rapprochement between developed and developing countries, recognises the Blue Economy as a credible alternative development paradigm. Various landmark declarations at Ministerial level indicate that more than one hundred countries have endorsed the relevance of the Blue Economy since 2007. The emergent 'blue voice' is becoming robust and has the potential to play an important role in shaping the future of the Blue Economy and its governance

Within the broad parameters of this still emerging paradigm, 'blue innovation' and 'blue tech' have been the most significant instruments in advancing 'blue growth', and the formation of a 'marine cluster' has been an important initiative. Furthermore, in the coming decades it is predicted that the Blue Economy will emerge as the driver of economic growth for several littoral states.

IORA and the Blue Economy

Of the twenty-one Member States of IORA, African states constitute the second largest regional group, comprising 9 out of 21 (43 per cent). Those Member States that have adopted specific measures to develop a Blue Economy within their jurisdiction have been guided by the continental and regional governance frameworks that aim to integrate the continent and bring about economic, social and cultural development. The continental and regional governance framework applicable to African Member States thus accommodates the notion of the Blue Economy.

SADC's call for deliberate action to align Blue Economy principles with its objectives recognises the calibre of contribution that a sustainable ocean economy can have for socio-economic development in the region, and especially for the east coast of Africa. The significant measures adopted by Mauritius, Seychelles, Kenya and South Africa in developing an oceans economy, as well as the desire of the other African Member States of the IORA to adopt similar measures, demonstrate the extent of the political weight behind the Blue Economy movement. Such significant support bodes well for the Blue Economy vision of Africa and the IOR as a whole.

As this compendium focuses on the Indian Ocean, the role of the largest regional organisation is foregrounded, namely the Indian Ocean Rim Association (IORA), which has its Secretariat in Mauritius. The First IORA Ministerial Blue Economy Conference on 'Enhancing Blue Economy Cooperation for Sustainable Development in the Indian Ocean Region' (September 2015) saw the adoption of the *Mauritius Declaration on the Blue Economy*, which seeks to harness ocean resources in a sustainable manner. The Declaration recognises the importance of the Blue Economy vis-à-vis fisheries and aquaculture in ensuring: food security and its contribution to poverty alleviation and sustainable livelihoods; renewable ocean energy to reduce the cost of energy and to mitigate and adapt to the impact of climate change; seaport and shipping to promote trade, investment and maritime connectivity in the Indian Ocean region; and offshore hydrocarbons and seabed minerals to foster new business opportunities and attract investment in the Indian Ocean.

During the first IORA Leaders' Summit in Jakarta, Indonesia in March 2017, Member States adopted the IORA Action Plan 2017-2021 and signed the Jakarta Concord to strengthen collaboration with a view to promoting regional cooperation for a peaceful, stable and prosperous Indian Ocean region. Further, Member States recognised the significance of the Blue Economy as a driver of inclusive and sustainable economic growth and development in the Indian Ocean region. At the Summit, leaders committed themselves to several areas, including *inter alia*: promoting maritime safety and security in the region; enhancing trade and investment cooperation; promoting sustainable and responsible fisheries management and development; enhancing disaster risk management; and strengthening academic, science and technology cooperation.

India has raised its 'blue voice', which is reflecting in its domestic and foreign policy. At the political level, the Prime Minister of India has taken the lead in shaping India's Blue Economy policy and has extended support to countries such as Mauritius, Seychelles, the Maldives, Sri Lanka and Fiji. In the Ministry of External Affairs, a separate division of the Indian Ocean region (IOR) has been created to spearhead policies relating to the Blue Economy along with the Ministry of Earth Sciences. The Ministry of External Affairs has initiated the Indian Ocean Dialogue

(IOD), an initiative that is meant to ensure scholarly exchange between the countries of the region.

Sustainability and the Blue Economy

The Sustainable Development Goals (SDGs) provide an unprecedented policy platform for integration across sectors and for balancing the economic, social and environmental benefits derived from the Blue Economy approach. Early analysis of the value of the SDGs focused on interactions between, for example, the energy sector and ocean health. But as the SDG debate has matured and more precise targets and indicators are specified, the opportunity to use these as the signposts for Blue Economy development, and for diversified metrics to measure progress, is becoming clearer.

The varied pressures and demands on ocean sectors that have led to the current decline in ocean health and the state of ocean assets are all projected to increase. As a result, there is a real risk of pursuing a 'weak' or unsustainable Blue Economy approach unless strong leadership and decision-making emerges. These risks are inherent in the body of practices adopted in recent decades. These practices can be described as the 'linear economy' threat, in which raw materials are over-exploited and pollution is returned to the environment; the focus is on fossil fuel energy-intensive and high-consumption products; there is a lack of attention to demographic change, including population growth and unmanaged migration, and fragmented sectoral planning; and priority is given to short-term profits.

Within this context, IORA should be encouraged to take the lead in developing sustainable Blue Economy policy in the Indian Ocean, from basin to regional and national level, and ensuring advancement towards an environmentally sustainable, socially equitable and economically viable future for Indian Ocean rim countries. More innovative technologies are required to generate new cash flows, to create new jobs and, consequently, to build social capital and ensure well-being.

Sustainability is the core of the Blue Economy, as reflected in the United Nations Conference on Sustainable Development, Rio+20, on Sustainable Development and in the Sustainable Development Goals (SDGs). SDG 14 needs to be linked more strongly to the Blue Economy, but several 'soft' and 'hard' challenges that are currently inhibiting the realisation of the Blue Economy and blue growth need to be faced. To address such challenges, the SDGs as a whole should inform and constitute national level development programmes worldwide. The strongest challenges to be faced are those in developing countries. The 'soft' challenges include: countries and regions achieving consensus on targets, indicators and outcomes; criteria for assessing country-level performance based on these indicators; and the

requisite regulatory and legislative framework to govern economic activities in the oceans so as to avoid any regulatory conflict between countries. Uniform standards and guidelines for licensing and best practices in ensuring sustainable ocean health need to be developed, and the active exchange of knowledge, the cross-pollination of ideas and capacity building are necessary so that agreed standards and guidelines are improved over time.

‘Hard’ challenges include: physical port infrastructure and the interconnected rail, road and telecommunication IT infrastructure; security cooperation; structures and controls against crime; information sharing across borders and between governments; trade infrastructure; conflict resolution between neighbours, especially in waters beyond the territorial boundaries of any specific country; and inter-regional and intra-regional value chain linkages for trade development.

Blue Economy and Gender Equality

In addition to the hard and soft challenges highlighted above, gender parity is another challenge requiring attention to ensure sustainable, equitable and inclusive growth. It is a moot point that the inclusion of women increases economic productivity, improves developmental outcomes for the next generation and makes policies and institutions more representative and effective. Therefore, Blue Economy expansion should be accompanied by greater participation by women. It should be noted that gender parity can be achieved only if a gender perspective is integrated, both theoretically and operationally, into the Blue Economy paradigm from the outset. Unfortunately, gender statistics are almost non-existent in most Indian Ocean Rim states, which makes status assessment and policy formulation all the more difficult. The systematic integration of gender in national statistics is therefore required to assist in identifying the challenges to gender parity and assist in building national and international policy consensus.

Capacity building and socio-cultural change are also imperative when it comes to reducing gender inequality. Women should be afforded ample opportunities to engage in technology-supported training and skills development and thus to move from low-value added activities to high-value added activities. The acknowledgement and sharing of local success stories of women workers and entrepreneurs on a broader platform and scale will contribute to a more conducive environment for their participation. It may motivate women to take the less trodden path and enter the hitherto male dominated ocean-related domain. Needless to say, the state and international development institutions have a crucial role to play in designing and implementing appropriate micro and macro level strategies for ensuring gender parity in the future growth of the Blue Economy.

Blue Economy and Ocean Governance

The Convention on the Law of the Sea (UNCLOS) highlights the international legal framework within which the Blue Economy operates in the Indian Ocean and in other regions. It is especially significant, considering the number of states that have ratified this instrument. The development of a Blue Economy, as advocated by the Member States of the Indian Ocean Rim Association (IORA), demonstrates the desire to advance their individual and collective economies within ecological parameters, and UNCLOS is the primary international instrument aligned with this vision. The Indian Ocean Rim Association (IORA) is therefore required to develop its regional architecture in line with the Convention's provisions on cooperation in the area of marine pollution, as well as in line with the rules of international law that are consistent with the Convention.

There is clearly a need for greater progress in creating a comprehensive system of ocean governance. Work must continue at an international level, especially in terms of gaining control of the high seas; at national level, the limited examples of good practice should be shared. Although an international system of governance is essential, regions constitute part of the Earth's surface and therefore share common characteristics - they are areas where people feel a certain degree of shared identity.

There is only one ocean, which surrounds the globe and, seen from space, it is the blueness of the planet that dominates. However, in a constant search for order, names are given to different geographical areas of this liquid mass. Apart from the three largest oceans, there are smaller ones that are, in effect, offshoots of the Pacific, Atlantic and the Indian oceans such as the Mediterranean, Baltic, Caribbean and South China seas, each of which have their own important characteristics. Within this fragmented and competitive context there is a case for creating a more ordered ocean environment, from which all nations may benefit. The goals are ambitious, but potentially rewarding, for all parties: a Zone of Peace, a flourishing Blue Economy, freedom of movement across the seas, and a sustainable future. But to work towards these goals, there must first be an effective means of governance in the regions.

Integrated Coastal and Ocean Management

Emergent ocean economy nations would gain considerable insight into the integrated coastal and ocean management of their sea-space by drawing on the experience of more established ocean economies in the region. By way of example, a number of important aspects of South Africa's Operation Phakisa Oceans

Economy (OP-OE) initiative could be considered by other IORA Member States, particularly those in the Western Indian Ocean region. Many of these aspects relate to ocean governance within the Marine Protection Services and Governance Delivery Area.

An important lesson learned is that the coordination of internal ministries in the governance of the Blue Economy is vital. Prior to the OP-OE initiative in South Africa, ocean use management was spread across a number of South African national departments, each with its own mandate. Although the individual delivery areas of the OP-OE are still the responsibility of different government departments, the establishment of an over-arching Ocean Secretariat and Inter-Ministerial Committee within the South African Department of Environmental Affairs (DEA) consolidates the ocean governance framework.

Furthermore, the historical multiple management mandates of the different departments meant that there were multiple legislative instruments under which ocean management was carried out. Review and integration of South African ocean legislation (such as the Integrated Coastal Management Act) will allow for the consolidation of these legislative instruments. The drafting of a Marine Spatial Planning Bill, and a national framework under this Bill, are important aspects of this work.

Fisheries and Aquaculture

Fisheries and aquaculture represent a major source of productive employment in the Indian Ocean region. The case studies of India and Mauritius clearly demonstrate the validity of this statement. Climate change, ocean acidification and global warming, and the pollution of marine and fresh water ecosystems could significantly affect the global production of fish. As the global population increases, several studies reflected in the text anticipate that the world's fish production will have to be increased significantly. Similarly, scientists have projected that climate change could engender substantial shifts in catch size and location. Given the environmental risks of over-fishing, the proper management of capture and aquaculture fisheries will soon become critical to ensuring the generation of more jobs in the fisheries and aquaculture sectors of the Indian Ocean region.

Ocean Renewable Energy

The Indian Ocean is bordered by countries in varying stages of development; the same is true of the hydrocarbon industry. As highlighted in the sections above,

some countries are already working together in the shared ocean space and have initiated training programmes. There are also a number of sector-specific and more broadly focused organisations in the region, which could be used to facilitate the establishment of a hydrocarbon industry in the Indian Ocean region. Such a step would benefit countries attempting to develop their hydrocarbon industry. The overlapping membership of different regional organisations could help to facilitate partnerships as over-arching cooperative agreements are probably already in place. Countries developing their hydrocarbon industries could therefore learn from those that already have strong regulatory practices, financial systems and environmental protection practices in place.

It is recognised that the hydrocarbon industry is not a particularly sustainable industry, but that there are benefits to developing the industry while alternative, reliable low carbon or renewable energy sources and/or technologies are considered. These benefits include job creation, energy security and additional revenue for governments. A review of the existing legislation in countries with a well-developed hydrocarbon industry would be beneficial to determine how other countries could increase their attractiveness for investment in Exploration and Production (E&P) opportunities.

However, the ocean represents a vast source of renewable energy. It provides countries with access to the ocean and those with an extended exclusive economic zone (EEZ) an avenue for extending their renewable energy base and minimising their dependence on fossil fuels and hydrocarbons. Energy from the ocean can be harnessed in multiple ways, ranging from the conversion of the kinetic energy of waves, tides and salinity gradient into electrical energy to the cultivation of algae biomass for conversion into biofuels. The ocean also provides the real estate for the construction of offshore wind and photovoltaic farms.

Given the treacherous and costly nature of ocean renewable energy technologies, the implementation of such technologies may not be happening on a large commercial scale as yet. Moreover, in the same way as earth-based systems, they may have inherent impacts on the ecosystem. It is thus imperative that countries that wish to adopt such systems carefully select the technology they wish to apply and assess its economic and ecological impacts to ensure long-term sustainability.

Blue Economy and Tourism

As has been mentioned a number of times, the Blue Economy shows significant potential for generating positive economic impact for the nations of the Indian Ocean region and for acting as a catalyst for regional economic growth. Tourism

is one of the best tools available for conserving the region's unique natural and cultural resources while generating employment. However, there are many challenges to the sustainable growth of coastal and marine tourism that can only be overcome if good governance practices are put in place. In all IORA countries there is the potential for public-sector organisations and agencies to work directly with private-sector enterprises to encourage good practice in the management and sustainability of tourism operations through advice, support and recognition. Visionary and committed private-sector leadership is essential for the development of tourist enterprises of benefit to society and communities and to facilitate the provision of incentives for conservation.

Local communities and the private sector have a central role to play in developing such systems. Fortunately, there have been some encouraging developments in the tourism sector, which point to increasing collaboration and shared governance processes among the countries of the Indian Ocean region.

Climate Change and Small Island Economies

The effect of climate change on ocean-dependent economies is similar around the globe, but each region nonetheless faces its own peculiar challenges. In the Indian Ocean region, these challenges may be summed up as low, to very low, levels of resilience. Resilience is defined as the ability of a system (natural or socio-economic) to absorb a shock and recover on its own. Nations in the Indian Ocean region have low levels of resilience for a number of reasons, the most important of which is the expense involved in building resilience. This is nowhere more evident than in small island developing states (SIDS), such as the Maldives and the Seychelles, where worst-case scenarios for a rise in sea level are life-threatening.

However, low resilience does not mean *no* resilience. The region regularly endures disruptions of the type likely to increase, in both frequency and severity, with climate change, and yet the region recovers, albeit with higher losses and longer timeframes than is necessary. Taking cognisance of climate change actually represents the possibility of transforming the Blue Economy into an opportunity to increase resilience.

Ocean Ethics

The realisation that the marine ecosystem is an important source of food and broader economic development has contributed to the inclusion of marine and bio resources in national accounting systems as natural assets that have

economic value. The mainstreaming of such natural resources in development planning and national accounts means that the human impact on their availability becomes a critical issue in systematic assessments and a key driver of policy. For instance, it is now known that activities related to the harvesting of food from the oceans, land-based activities that have an impact on sea life and conditions and the introduction of marine pests are key drivers of any changes in the stock of bio-resources.

A key requirement for the optimal management of this unique, but fragile, ecosystem is the development of environmentally sensitive techniques for exploiting ocean resources. There is an argument, therefore, for the development of 'ocean ethics', accompanied by a fundamental and far-reaching change in attitudes and values, in line with the rapid pace at which the system itself adapts to external pressures. For such a change to occur, a good understanding of current practice and the mind-set vis-à-vis marine systems should be promoted, and governance systems strengthened.

Inter-country Planning

The concept of the Blue Economy requires that planning and implementation occur on a scale relevant to ocean systems. The whole-basin scale is the largest scale relevant to the Indian Ocean, but it is more pragmatic, on a regional scale, to consider planning in accordance with sub-units, as determined by ocean processes. The Large Marine Ecosystem approach is one that has successfully identified an appropriate scale for the consideration of ecosystems and their economic and human dimensions. Its existence was also the motivation behind certain funding decisions taken by the Global Environment Facility.

Within United Nations frameworks, inter-country planning and negotiation processes need to be expanded and strengthened to meet such challenges, and to cover waters falling under national jurisdictions as well as those falling under international jurisdiction. Both Asian and African processes recognise the growing need for regional and sub-regional integration to ensure that development continues to improve and that Blue Economy approaches are implemented.

Scientific Research and Development

It is important to encourage investors to venture into projects associated with the Blue Economy. The pursuit of scientific research in the related multi-disciplinary areas of the ocean economy is crucial to the creation and transfer of knowledge. A

Mauritian case study demonstrates that capacity building in this sector should address the human resource requirements for the development of the Blue Economy. This would require emerging sectors, such as ports, aquaculture, renewable energy, tourism and marine biotechnology, and renewable marine resources, to be identified as these could further support economic development and create sustainable job prospects. New blue growth areas, such as bio technology and the promotion of start-up firms, should be supported by the venture capital market. The funding of research and development (R&D) is closely linked to collaboration in research groups and science-industry interactions. In addition, it is submitted that IORA Member States should focus on the formation of clusters, incentive structures for researchers, and on policies to increase the mobility of experts within the science system and between science industries. Inter-IORA mobility of highly skilled workers/ technicians/ scientists should be encouraged through appropriate policy measures, and it would be commendable if IORA were to evolve a sophisticated architecture of science and technology cooperation for the promotion of the Blue Economy in the region.

Blue Economy: a Paradigm Shift?

As we started, so we end. Whether the Blue Economy is indeed a paradigm shift will depend on certain, necessary, developments. The replacement of a 'market mechanism' for allocating ocean/ marine resources is yet to be evolved. Although the market mechanism has been criticised by many scholars, including those who have contributed to this Handbook, there is as yet no alternative to it. Innovative business models need to be developed within the Blue Economy framework to promote inclusive growth. As we move into the future, necessary and sufficient conditions need to be met if the Blue Economy is to represent a true paradigm shift.

Notes and References

- 1 Meadows, D. H., Meadows, D. L. and Randers, J., 1972. *Beyond the Limits to Growth*.
- 2 Ibid, p.23
- 3 The proposal to declare the Indian Ocean a zone of peace was unanimously adopted by the General Assembly in 1971. The Assembly declared that the Indian Ocean, 'within the limits to be determined, together with airspace above and the ocean floor adjacent to it,' be designated a zone of peace. The proposal was a brainchild of Sri Lanka and was endorsed by the 113-member Non-Aligned Movement. The concern underlying the 1971 declaration was the steady escalation in the arms race and the

competitive military presence in the region. Available at: <http://www.worldlii.org/int/other/UNGA/1971/74.pdf>; <http://www.worldlii.org/int/other/UNGA/1971/74.pdf> [Accessed 6 August 2017].

The Blue Economy Handbook of the Indian Ocean Region

As humanity enters the Anthropocene epoch the oceans are more at risk than ever before as a result of the increased exploitation of its resources. The Indian Ocean is the third largest ocean in the world comprising 20% of the water on the Earth's surface. The sea lanes in the Indian Ocean are among the busiest in the world with more than 80 percent of global seaborne trade in oil transiting through the Indian Ocean and its vital choke points and an estimated 40% of the world's offshore oil production comes from the Indian Ocean. The importance of this region cannot be underestimated and there is no doubt that there are many opportunities for economic growth and job creation presented by the waters washing the shores of the Indian Ocean Rim. In order to ensure a desirable future for humanity it is necessary to make use of the ocean's resources in a sustainable and responsible manner.

Climate change is affecting the Indian Ocean negatively, placing a strain on the ability to ensure food security and damaging the economies of small island states that depend on fisheries and aquaculture for their livelihoods. Increasing ocean temperatures and ocean acidification are taking a toll on ecosystems.

This book is the first of its kind, providing fresh insights into the various aspects and impacts of the Blue Economy in the Indian Ocean Region: from shifting paradigms, to an accounting framework, gender dynamics, the law of the sea and renewable energy, this handbook aims at increasing awareness of the Blue Economy in the Indian Ocean Region and to provide evidence to policy-makers in the region to make informed decisions. The contributions are from a mixture of disciplines by scholars and experts from seven countries.

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